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BIBLICAL MANUALS.
EDITED BY PROF. J. ESTLIN CARPENTER, M.A.

THE METHOD OF CREATION.

A COMPARISON OF THE BOOK OF NATURE WITH THE BOOK OF GENESIS.

BY
HENRY W. CROSSKEY, LL.D., F.G.S.

Second Edition.

LONDON:
THE SUNDAY SCHOOL ASSOCIATION,
ESSEX HALL, ESSEX STREET, STRAND, W.C.
1889.

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JUL 14 1883

"I HAVE seen
A curious child, who dwelt upon a tract
Of inland ground, applying to his ear
The convolutions of a smooth-lipped shell;
To which, in silence hushed, his very soul
Listened intensely and his countenance soon
Brightened with joy; for from within were heard
Murmurings, whereby the monitor expressed
Mysterious union with his native sea.
Even such a shell the Universe itself
Is to the ear of Faith: and there are times,
I doubt not, when to you it doth impart
Authentic tidings of invisible things,
Of ebb and flow, and ever-during power,
And central peace, subsisting at the heart
Of endless agitation."

—*Wordsworth.*

"We know also that the beginning is the chiefest part of any work, especially in a young and tender thing; for that is the time at which the character is being formed, and most readily receives the desired impression.

"Quite true.

"And shall we carelessly allow children . . . to receive into their minds notions which are the very opposite of those which are to be held by them when they are grown up?

"We cannot."

—*The Republic of Plato.* (*Jowett's Translation.*)

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PRELIMINARY NOTE.

THE object of this little book is to enable young people, when they are taught the ancient ideas contained in the Bible respecting the way in which "*the Heaven and the Earth were finished*," to become acquainted, at the same time, with some of those principles of investigation and ascertained facts by which light has been thrown upon the method actually employed by the Creator.

It is not intended to be a scientific manual, and does not pre-suppose a technical acquaintance with Geology as a science; but is an attempt to make certain great laws by which the work of Creation has been carried on as intelligible to those who are not geologists as are the rudiments of Astronomy to those who are not astronomers.

The necessity of such a book is emphasised by the popular demand for the acceptance of the account given in Genesis as a condition for discipleship of Christ. The author has known many cases in which young men and women have had their faith in God rudely shaken by the discovery that what is taught concerning the creation of the world on the authority of the Book of Genesis can receive no support from the authority of Science. He is confident that any concealment of the

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facts of Nature can only weaken the hold of Religion upon the heart, and he has, therefore, written with frankness, although, he trusts, not without reverence for a Book which is so widely regarded as "sacred," and contains so much to justify the devout respect paid to it.

Some few technical words are of necessity employed, but their meaning will readily be gathered. In the opinion of the author the use of the right words will be found to make his arguments clearer than they would be were vague phrases substituted.

H. W. C.

NOTE TO SECOND EDITION.

A FEW paragraphs have been added to this edition which will, perhaps, make the meaning clearer; but the alterations will not really affect the use of the new edition in schools which already have the old one.

H. W. C.

October, 1888.

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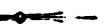

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THE

METHOD OF CREATION.

CHAPTER I.

THE LAWS OF NATURE, THE REVELATION OF THE WILL OF THE CREATOR.

Do we know anything about the creation of the world in which we live? Can we learn what its condition was before it was inhabited by man? how its solid rocks were upbuilt, and its present plains, valleys, and mountains were formed; by what processes the position of its lakes, the courses of its streams and rivers, the boundaries of its seas, were determined? Is it possible to trace the history of the grasses of the field, the herb yielding seed and the fruit-tree yielding fruit, together with the history of the birds of the air, the living creatures that move within the waters, the cattle and creeping things and beasts of the earth after their kinds; and say how they obtained their varied forms, and when they first appeared in the districts in which they are now found? Can we fix the period when man came into existence?

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The interest and value of such inquiries as these are very great.

The pursuit of knowledge is in itself ennobling. Unless the mind be filled with great thoughts, mean purposes and ignoble desires will take their place and exercise an unhallowed influence over the conduct of life. The lack of intellectual occupations will deprive us of some of the highest delights of which our nature is capable, and render our days far more miserable than they ought to be. "The human heart," said an old Archbishop of Mayence, "is like a millstone: if you put wheat under it, it grinds the wheat into flour; if you put no wheat it still grinds on, but then 'tis itself it wears away.'"

Investigations into the method of Creation not only arouse mental activity and furnish sublime subjects for studious thought; we may also hope to obtain from them unquestionable revelations of the Wisdom and the Will of the Maker of Heaven and Earth and all that therein is. It is of grave and solemn importance that we should understand what are the attributes and the requirements of the Lord who breathed within us the breath of life; and his works—the worlds without us as well as our own souls—must be the sources of our surest knowledge.

Acts of Parliament express, in England, the decisions of human legislators as to the laws under which we ought to live; the Churches of the land tell us what they severally deem to be holy articles of faith; but the revelations of God as they are manifested in what is termed "Nature" rest upon a higher authority, and are more certainly to be received as wise and just. "Nature"

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is the name given to all the creations of God, when considered collectively as forming one vast system; and includes, in its broadest sense, the constitution of man himself, as well as of the earth his dwelling-place and the stars that gem the sky. The only distinct meaning of the word "natural" is (according to the great philosopher Butler) "stated, fixed, or settled."

The study of "nature" is the study of what is (so far as man's highest knowledge enables him to judge) "fixed, or settled" in the universe in the midst of which we dwell, and within our own bodies and souls. The facts which are discovered as this study is pursued, were not fixed and settled by man, and have never been altered by human agencies.

Neither by the decree of any Church nor by any Act of Parliament could the elements be made to combine in any other proportions than those in which they do combine; or steam, heat, and electricity be compelled to do any other work than that which they do. Nothing would be more palpably absurd than for the strongest Government on earth to enact a law that the seed of thistles should produce grape vines, or that the sun should appear above the horizon at the same hour in winter as in summer—the seed of thistles would still produce thistles, and the dawn would break at the accustomed moment in each successive season. "Which of you," asked Jesus Christ, "by taking thought can add one cubit unto his stature?" We ourselves have not fashioned our bodies as they are; and the laws by which their growth is guided are not our own arrangements. So is it with the millions of worlds that fill the vastness of space; their formation—their motions

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— their changeful histories — have been beyond the control of man.

Whatsoever discoveries may be made by scientific research must therefore be humbly received without doubt or suspicion, as clear and certain revelations of the will of the Lord, who alone has determined the methods by which this earth, the worlds around, and man, have come into existence, and established the laws in accordance with which they are actually governed.

When we gaze on noble buildings or lovely pictures, when we hear sweet music, and when we read great books, the men by whose genius they were produced are made known to us in all the glory of their marvellous intellectual powers. The minds of men are revealed to us by their works. When we study "Nature," we are taught as plainly and indubitably what is esteemed lovely, true, and right, by the great and awful Being by whom all things were fashioned.

It directly follows that any "creed" concerning God which contradicts a single scientific fact must necessarily be, to that extent, untrue.

Many excellent and religious men have feared lest the study of the laws of nature should destroy rather than deepen our faith in God. They have been strangely unwilling to believe that the universe is governed in accordance with fixed, definite, and irresistible laws, under the vague impression that by the admission of such a fact they will be compelled to substitute the forces of nature for the authority of God.

Flashes of lightning were at one time thought to proceed directly from the throne of God, and to be in-

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tended to terrify men in their sins. When the natural causes of thunderstorms were detected it was seen that danger could be averted by the erection of conductors. Some religious men, however, refused to believe that any safety could be found in a lightning-conductor, on the ground that God would refuse to be interfered with, and that no attention to a "law of nature" could be expected by pious souls to furnish any protection against his wrath.

A church in Sienna, so runs an old tale, had often been injured by lightning, and a conductor was set up; but it was condemned by the people of the town as a wicked attempt to thwart the power of God. A storm came; crowds flocked to the church, expecting that the Almighty would strike and overthrow it in his anger—yet the conductor did its work and not a stone was touched. When Newton announced the theory of gravitation an objection was taken to it on religious grounds. It was declared to be subversive of faith in God to believe that bodies naturally moved towards each other, instead of being directly guided by his hand. Even in the nineteenth century when Darwin—one of the greatest men of science who ever lived, with unrivalled knowledge and marvellous intellectual power—investigated the origin of the myriad varieties of plants and animals now existing on the earth, he was, for a kindred reason, condemned as an Atheist.

Darwin maintained that the thousands upon thousands of different kinds of plants and animals now found in the world were not originally created just as we see them, but that they have all descended from some few beings which lived ages ago; and he endeavoured to

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trace the natural laws in accordance with which all the elaborately-constructed forms of the plants on our tangled banks, the birds singing on the bushes, the insects flitting about, the worms crawling in the damp earth, the beasts wandering in the forests, the fish swimming in rivers and lakes and seas, which are so different from each other, have been produced. The books, in which he brought together a vast number of facts, and stated what he believed to be the laws sustained in action around us now, as well as operative in past times, were, however, denounced as destructive of religion altogether.

Darwin's theory of the origin of the various species of our plants and animals may be true or false—it will require years of investigation to test it thoroughly—but everyone beginning to think on the great and wonderful questions raised in the first chapter of Genesis should clearly understand that it is not in the least degree irreligious.

Suppose a piece of waste ground, to be suddenly filled with plants in full bloom, brought down by Angels out of Heaven—that would be one way of creating a flower-garden; but it is not the plan adopted by the Creator. We have to plant seeds, and observe the conditions imposed upon their growth. The wisdom and power of God, however, are at least as marvellously shown in the growth of a seed as they would have been were each flower formed without the employment of a seed at all, directly by His hand. In the same way the production of all the varieties of plants and animals upon earth, and the action of certain laws adequate for the purpose, is as much the work of a Creator as the formation of every

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plant and animal, independently, and by itself, could possibly be.

The last words in Darwin's "Origin of Species" are these: "There is grandeur in this view of life, with its several powers, having been breathed by the Creator into a few forms or into one; and that whilst this planet has gone cycling on according to the fixed law of gravity from so simple a beginning, endless forms most beautiful and most wonderful are being evolved."

So prevalent is the idea that the carrying on investigations into the laws by which the Creator works is equivalent to questioning whether the world has had a Creator at all, that Prof. Agassiz has said, "whenever a new and startling fact is brought to light in science, people first say 'it is not true;' then that 'it is contrary to religion;' and lastly, 'that everybody knew it before.'"

Confusion of mind will be removed by understanding exactly what is meant by a *Law of Nature.*

A law of nature means that all the changes that take place in the outward universe—that is, all natural phenomena—are observed to follow each other in the particular series to which they may severally belong in a certain order without variableness or shadow of turning. The action of certain forces, and the combinations of certain elements, being ascertained in one case, they will be found invariably to recur whenever the same conditions prevail. When, for example, a light is applied to the powder called gunpowder, it explodes—and whenever the same powder is used, and a light applied, the same result will follow. What electricity does to-day it will do to-morrow; the proportions in which oxygen and hydrogen combine to form water on

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one occasion will hold good whenever those gases meet again. Experiment shows that if the distance between two bodies be doubled, the force of attraction between them will be only one-fourth as great; if the distance be trebled, one-ninth as great; if quadrupled, one-sixteenth as great—hence it is said to be a "law of nature" that the force of gravitation varies inversely as the square of the distance. What is meant is that whenever the same experiment is repeated the same result will be obtained. In other words, laws of nature are fixed sequences among the phenomena of the universe.

The "laws of nature" are not alive; they have no power of their own; they can do nothing of themselves. They are simply succinct summaries of the observations made by man regarding the order in which the various events that take place in the physical world follow each other.

A law of nature has no more power to compel obedience than has the law of England. An Act of Parliament cannot *put itself* into execution. An executive authority is needed for the enforcement of the law of the land, just as an intelligent authority is required for its enactment. Without police, magistrates, and judges, the criminal code would be a dead letter. It would be in vain for the law to say "thou shalt not steal," if there were no power behind the law to bring the offenders to justice. A law of nature requires in the same way a supreme executive Authority for its enforcement, as well as an infinitely wise Authority for its establishment as a law at all. A resistless Power must be at work behind it, or it could not be sustained in constant and changeless activity.

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The phenomena of nature could not follow each other in the order observed to exist among them were it not for the abiding support of a Being by whose will it is determined, hour after hour, and age after age, that so it shall be.

"What is natural," writes Butler—that is what is stated, fixed, or settled—"requires and presupposes an intelligent agent to render it so."

By inquiring, therefore, into the method by which the world was created, and the laws by which it is and has been governed, we shall obtain an actual revelation of the truth of God.

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CHAPTER II.

HOW KNOWLEDGE OF THE METHOD OF CREATION CAN BE GAINED.

In what way can we gain any real knowledge of the method of creation? No human being can by any possibility have been present while this earth was being fashioned, and have actually watched the Creator at his work. No books were written by the first men who ever lived, to describe even what they might have seen going on around them. How, then, can we know anything at all about what happened before the world was inhabited by rational beings capable of recording their thoughts?

The method of creation can be discovered by studying the forces now in active operation in the world. The world as it is is the key by which the history of its past can be interpreted.

The walls of the old Egyptian temples and rock-hewn tombs are covered over with a peculiar kind of picture-writing cut in the stone, known as "hieroglyphics," or "sacred carvings." For many hundreds of years the knowledge of the meaning of these characters was lost. But at length a large block of stone was found by the French in digging a well at Rosetta, in Egypt, which supplied the missing key.* It contained

* This stone, known as the Rosetta Stone, from the place where it was brought to light, is now in the British Museum.

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three inscriptions in different kinds of writing. The last was in Greek which could be read easily, and this ended with the information that the decree engraved upon it was ordered to be given in three different characters; (1) in the ancient sacred letters; (2) in the ordinary letters of the country, and (3) in Greek.

By putting these three inscriptions side by side and examining them letter by letter, and word by word, the meaning of the "sacred letters" or hieroglyphics became intelligible. By the known letters of the Greek language the unknown forms were interpreted. So is it in the study of nature; we must proceed from the known to the unknown. "Man," writes Bacon, "the servant and interpreter of Nature, understands and reduces to practice as much as he has actually experienced of Nature's laws; more he can neither know nor achieve."

The great logician, J. S. Mill, points out that inquiries into the way the world was made are no more illogical or visionary than judicial investigations which aim at discovering a past event by inference from those of its effects which still subsist.

"As we can ascertain whether a man was murdered or died a natural death from the indications exhibited by the corpse; the presence or absence of signs of struggling on the ground or on adjacent objects; the signs of blood; the footsteps of the supposed murderer, and so on, without any mixture of hypothesis; so if we find, on or beneath the surface of our planet, masses exactly similar to deposits from water, or to the results of the cooling of matter melted by fire, we may justly conclude that such has been their origin." (Logic, II. 26.)

I once, for example, descended a mine and broke off

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a piece of coal at a place where the seam was pierced by a hard rock which was not coal at all. The mass of coal in the mine evidently consisted—as all true coal does—of a compressed vegetation ; the stems and leaves of plants and trees being found in it, and a fibrous, woody structure being not unfrequently observed when thin slices are cut and placed beneath the microscope. But on examining this particular piece of coal I found it to have been thoroughly burnt, while the rock that had been thrust through it was of the same character as the lava that flows from volcanoes. Four conclusions were irresistible, 1st, that what is now coal many fathoms beneath the soil was once part of a forest on the surface ; 2nd, that the forest decayed and its remains were thrown down upon each other ; 3rd, that a volcano poured through the consolidated mass a stream of lava scorching and burning it, in its passage ; 4th, that the crust of the earth must have been in motion, since otherwise the remains of forests could not be found as coal beds many fathoms beneath its present surface.

I take a block of limestone from a cave near Dudley in the centre of England, and I find it almost entirely composed of corals.

There can be no doubt that the origin of this limestone is due to the labours of animals that lived in the sea ; and that the sea must once have flowed over our dry land.

I have before me a slab of sandstone (which I broke off with a hammer from the side of a hill in Scotland) covered with undulating ridges. Walking on the seashore when the tide is out, I find that this sandstone is composed of exactly the same kind of particles as those

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which are there beneath my feet; and I further observe that precisely the same curious ridges as those which are preserved upon it, have been made upon the sands by the advancing and retiring waves. I conclude without hesitation that the hard sandstone rock from which I took my specimen, was once as soft as the sands of the shore, and that the waves in ages past must have rolled over it.

I bring home from the Sussex downs a piece of chalk. Reducing this piece of chalk to powder, and placing it under the microscope, I see that it contains hundreds of minute shells—the remains of marine creatures called Foraminifera. Obtaining some ooze dredged from the depths of the Atlantic, I detect shells of exactly the same type, and in one or two instances of indistinguishable species, in equal abundance. The conclusion to be drawn cannot be disputed:—the chalk downs of England must at one time have constituted the floor of a great ocean, or branch of a great ocean.

Wandering over the fields in the Midlands, I come across hundreds of huge blocks of granite; and many other crystalline rocks. I can find no rocks like them in the neighbourhood. I have to journey to the Lakes of Cumberland, or to Kirkcudbrightshire in Scotland, or to Wales, to find mountains composed of them. I ask, how did they manage to travel so far away from their homes? They are too numerous and too enormous for any river to have rolled them along over so many miles of country. Moreover, many of them are so angular in shape and so curiously marked with grooves and scratches, that they could never have been rubbed against each other in river beds. Had they been waterworn they could not have preserved their peculiarities.

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I notice that in Switzerland, the glaciers, as they move down from the mountains to the valleys, carry along with them huge blocks of the same shape, and marked in the same way. I read of icebergs floating away from the Arctic regions laden with great blocks of stone, torn from northern lands, which they drop as they melt to the bottom of the sea.

Knowing what ice—in the shape of glaciers and icebergs—is now doing, I am compelled to believe that the scattering of boulders from Cumberland, and Scotland, and Wales, over the Midlands, must have taken place when an Arctic climate prevailed in Great Britain, and its mountains were covered with snow, its valleys filled with glaciers, and icebergs floated over its seas.

The very smallest amount of observation shows that the climate of a country affects its vegetation. The trees and flowers growing in lands which during winter are covered with snow do not belong to the same species as those flourishing at the Equator.

In the rocks within the boundaries of the Arctic circle the remains of a wonderfully luxurious vegetation are imbedded. Once upon a time, in those regions, now icebound and desolate, several species of Sequoia, one of the very largest trees in the world, grew; the magnolia blossomed; chestnut, walnut, and plum trees bore fruit; the vine brought forth grapes; mushrooms sprang up in the green fields; and the glades among the forests were filled with waving ferns. Judging the past from the present, we are bound, therefore, to believe that many changes of climate took place before our present zones of temperature were established.

In the beds of sand on our sea-shores many shells are to be seen; some are perfect, and have their empty

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valves filled with sand; the single valves of others either quietly rest on the smooth surface, or have been washed together in heaps.

The traveller in South America finds at heights which range from a few feet to between 400 and 500 feet above the sea level rows upon rows of immense sand dunes laden with shells, rising one behind the other, over a distance of more than 1,000 miles. These sand dunes are not only precisely similar to those existing upon the shore, but the myriads of shells they contain are of species still existing as the commonest in the adjoining ocean.*

Again, therefore, judging the past from the present, it is concluded that the sand dune at each successive level must represent an ancient shore of the sea; and that, consequently, a vast tract of land in South America, extending over a distance equal to that between London and the North Cape in Norway, has been gradually and quietly uplifted since the creation of the species of "shell fish" (mollusca) that now live in the neighbouring waters. Corresponding evidence of the upheaval of the land from the depths of the sea may be found in every part of the world.

The remains of plants and animals imbedded either in the solid rocks or in mud and sand accumulated before the history of man began, are called fossils. Lyell's definition of a fossil is as follows:—"By a fossil is meant any body, or the traces of the existence of any body, whether animal or vegetable, which has been buried in the earth by natural causes."

Fossils occur in the rocks at great elevations, having been observed at the height of more than 8,000 feet in

* *See* Darwin's "Naturalist's Journal."

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the Pyrenees, 10,000 feet in the Alps, 13,000 feet in the Andes, and 18,000 feet in the Himalayas.

The question to be answered is, how did the remains of plants and animals get into the very heart of masses of rock?

What is now happening must be carefully observed.

Rivers are constantly bringing down mud, sand, and gravel, into the sea; and the sea itself is always wearing away rocks and stones into minuter and minuter fragments. All this débris is spread out by the moving water in layers, and when animals die they are buried in it. Whenever there is a depression of the sea-bottom, or any hollow in the bottom of the sea occurs, there layers are deposited one over the other; and a thick mass of them is formed.

Thousands of branches of trees, leaves, and insects, together with the bodies of birds and other animals, are carried into every lake. At the same time the streams, flowing from the valleys and mountains, bring down sediment from the chasms in the rocks, and the soil of the fields through which they pass. This sediment covers over the various objects which have been blown by the winds, or have fallen, or have been swept by the streams into the depths of the lake.

Very many of the remains of plants and animals contained in the rocks—"fossils," as they are termed—were clearly placed in their present position by rivers, lakes, and seas, in the way described. Although the material—the matrix—in which they are found is now hard, it must have originally been soft. Leaves and ferns are spread out as delicately as when they are seen quietly lying on the ground; the feathers of birds have left their impressions; every bone of a fish is often in its

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proper place; the slender branches of the plant-like animals called zoophytes, with their minute cells, are arranged as naturally as when they covered the under surfaces of sea-weeds; the skeletons of enormous animals are, at times, perfectly preserved, not one of their limbs being absent.

Every kind of proof can be furnished that the plants and animals represented by "fossils" were as truly alive as those now upon the earth, and in the air, and within the water. They are found in every stage of growth, young and old; there are fossil seeds and fruits as well as fossil leaves and branches; the half-digested food of creatures, long extinct, occurs in a fossil condition, showing the kind of fish upon which they preyed, and the very footprints they made as they wandered over the soft sands can be seen upon slabs of the hardened rocks forming our solid land. The cuttle-fish affords a remarkable illustration of the way in which the study of creatures, now existing, enables us to understand the nature of those that are extinct and can only be collected as fossils.

The cuttle-fish has a leathery sac, called an ink-bag, in which it stores up a black pigment. When it is attacked it pours out a dark colouring matter, which hides it from the sight of its foe. I have taken one from the sea and placed it in a bucket of water and touched it with a stick—immediately the water became as black as ink, and the creature itself could no longer be seen.

Almost in the very middle of the rocks which compose the crust of the earth fossil remains of cuttle-fish occur—and their very ink-bags are found with the colouring matter so well preserved that it has been

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made into a paint. Without question, therefore, the fossil cuttle-fish in the rocks must have been as thoroughly alive and as capable of self-defence, by darkening the water, as the cuttle-fish dwelling in our modern seas.

Fearful showers of dust and ashes, and vast sheets of lava, issue from volcanoes, and cover woods and fields, villages and towns. Two ancient towns in Italy, Herculaneum and Pompeii, were in the first century of our era buried beneath these products of volcanic action. Excavations have been made, and visitors can walk in their silent streets. When the lava is taken away the rooms of the houses can be entered and the very pictures on the walls can be seen. The burial of Herculaneum and Pompeii beneath the lava illustrates the way in which it is proved that some ancient forests now entombed within solid rocks were once similarly overwhelmed.

On the N.E. shore of the Isle of Arran are some beds of volcanic ash. On breaking into these beds they are found to envelope large trunks of trees, which have their roots extending downwards into layers of hardened mud. Broken-off branches are also covered up by the volcanic ash around the stems of the trees. There are no less than eleven beds of volcanic ash, showing that eruption followed eruption. More than this, one forest has been destroyed by the volcano—and then another has grown—and has been overwhelmed in its turn.

"The structure of the plants points to their having grown in a marsh or estuary, at or below the sea-level; and the layers of ashes in which they are buried must have been showered forth by some neighbouring volcano,

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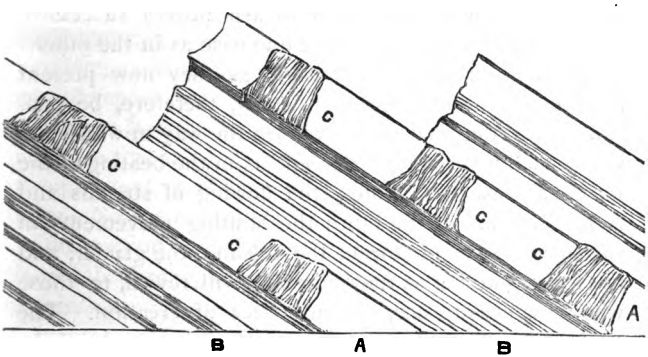
either subaerial or submarine. The frequent repetition and alternation of these beds indicates a long-continued period of volcanic action, with intervals of repose, during which vegetation flourished, and vegetable matter accumulated—forming thin seams of coal, which had in turn been covered up by fresh showers of ashes, and to which again succeeded a fresh growth of vegetation. At the same time, the land must have been slowly subsiding, as is evidenced by the sedimentary character of the layers of ash, overlying each other."*

The subjoined diagram shows the position of these ancient forests imbedded in volcanic ash, as they succeeded each other; and the way in which the beds of rock which were thus formed have been subsequently tilted up.



A A hard volcanic ash.
B B seams of coal and ash in alternate layers.
C C stems of trees sending down roots into the bed below.

* On the Occurrence of Fossil Trees imbedded in Trappean Ash in Arran, by C. A. Wünsch. Geol. Soc. Glasgow, vol. ii., p. 97.

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The proof of these facts in the history of creation is precisely of the same kind as the proof that Herculaneum and Pompeii were towns, inhabited by human beings and destroyed by a volcanic eruption. Herculaneum and Pompeii may be called fossil towns. We know that they were inhabited by human beings—because we find their skeletons, and their buildings, their utensils, and their works of art. We know that they were destroyed by volcanic agency, not only because history tells us, but because the material which covers them is of the kind that comes from volcanoes. The trees in the Isle of Arran have their structure as exquisitely preserved as that of the houses in the buried towns—and the character of the rock by which they are enveloped is undoubtedly also volcanic. The superposition of layer upon layer of ash proves successive eruptions as completely in the one case as in the other.

The facts and laws of Nature, as they now present themselves to our observation, must, therefore, be consulted in order that we may learn the way in which the world itself was made. The effects of the beating of the waves against the shore; the flowing of streams and rivers; the fall of the rain; the shifting movements of the air in wind and storm; the volcano, the glacier, and the iceberg acting as they now act, will reveal, to those who have eyes to see, the mysteries of creation. The explanation of the phenomena of past ages must be sought for in the facts and laws of Nature as they now come under direct observation. The way to obtain real knowledge is to place all the processes, now going on in the world, side by side, as it were, with the rocks, and discover by which of those processes the rocks

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could have been formed, brought into their present positions, and filled with forms of animal and vegetable life. We are only guessing and speculating, unless we (1) confine ourselves to known forces; (2) treat those forces as having always been subject to the laws according to which their action is now regulated; (3) ascribe similar results to similar causes.

The principle I have been illustrating has been clearly stated by Prof. W. S. Jevons:

"Science arises from the discovery of identity amid diversity. In every act or inference of scientific method we are engaged about a certain identity, sameness, similarity, likeness, resemblance, analogy, equivalence or equality apparent between two objects. . . . The whole value of science consists in the power which it confers upon us, of applying to one object the knowledge acquired from like objects; and it is only so far, therefore, as we can discover and register resemblances or differences that we can turn our observations to account. It must be the ground of all reasoning and inference that what is true of one thing will be true of its equivalent, and that under carefully ascertained conditions Nature repeats itself."

One caution is necessary to secure the right application of this principle in our researches into the method of creation.

It must not be supposed that we may not find evidences of changes more vast and extraordinary than any of which we either have had, or can have experience. The earth may have been, during the earliest period at which it could be called an earth at all, in a far more heated condition than at present; and have been gradu-

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ally cooling down from age to age. Should this have been the case, in the first stages of its history, its crust would shrink and contract to an extent and with a violence that has never been repeated; while in later times the amount of volcanic energy exhibited, and the rate of subsidence and elevation, may have diminished. The point to be noted, however, is that the questions whether this cooling down of the earth ever took place, and what were its consequences, must be answered by reference to those physical laws which are discoverable by observation and verifiable by experiment. No change can have been so vast, and no catastrophe so extraordinary, that it must not have taken place—so far as it can become a subject of our knowledge at all—in accordance with those laws of Nature with which we can only become acquainted through their active operations in the world around us, and among the stars of the sky. It is certain that "in the beginning," when this earth appeared as a distinct star, it was not in the condition in which we find it to-day; it is equally certain that all, or almost all, the plants and animals by which it was originally inhabited have been destroyed and replaced by new species. The world at every epoch in its history has differed from the world as it was in the epoch immediately preceding, alike in the boundaries of its continents and seas, and in the characters of its plants and animals. The events of one epoch have never been exactly repeated; and creatures that have once become extinct have never been created again.

What is meant by saying that "under carefully ascertained conditions Nature repeats itself," is *not* that new conditions of things have never been introduced into the

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world, but that whenever the same conditions of things, whether old or new, have been established, there has been a repetition of the same results. The laws of Nature which we discover to be actually enforced by the sustaining power of the Creator in any part of the world or at any period of its history, that is, may be confidently relied upon to act in the same way whenever and wherever they are detected in action at all. A simple illustration may make this clear. The eyes of many living crabs and insects are composed of a great number of lenses; the fly, for example, has two "compound" eyes, which consist of about 4,000 convex lenses, disposed in regular rows upon the projecting surface. We know the laws of light, and how these eyes enable the creatures that possess them to see.

Ages ago the sea swarmed with crab-like animals called Trilobites, whose eyes were constructed on the same principle; as many as 400 individual lenses have been counted in each eye of some forms. These trilobites began to live long before our coal-beds were deposited; they are quite extinct, and we know nothing of them except from fossil specimens. Why do we believe that trilobites could see? Because we rely upon the laws of light, established and enforced by the Creator, as having acted, millions of years ago, precisely in the same way as they do when the sun rises to-day.

This illustration also helps to show the meaning of the statement that "the whole value of science consists in the power which it confers upon us, of applying to one object the knowledge acquired from other objects." The eye of the living fly enables us to understand the construction of the eye of the extinct trilobite; and

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whenever an extinct animal is connected with a living creature by some similarity in its organization it must be studied in the light of that relationship.

From the various considerations that have now been urged, it appears that in order to obtain real knowledge of the way in which the world was made we must accurately observe the facts of Nature and ascertain the laws which the Creator himself is at the present moment enforcing among all his works.

One difficulty in the way of making this statement credible is a very general suspicion that so wonderful an event as the formation of a world could not have been effected by agencies such as those with which we are familiarly acquainted. When Jesus Christ taught in the synagogue of his own country people were astonished, and said, "Is not this the carpenter's son? Is not his mother called Mary? and his brethren James and Joses, and Simon and Judas? and his sisters are they not with us? whence, then, hath this man all these things?" And so when the scientific man points to the ordinary laws of Nature to explain creation, it is asked, "Do we not know these laws through our every-day experiences? How, then, could they have ever accomplished so marvellous a work?"

A considerable portion of the crust of the earth consists of *sedimentary strata;* that is of layers of mud and sand which (1) have been spread out by the action of water at the mouths of rivers, beneath the sea, and in the beds of lakes, and (2) then have been uplifted and become dry land, and (3) have been hardened and consolidated by their pressure upon each other. So far as our dry land is composed of these strata, it is the *wash* of previously existing continents.

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When, however, men are asked to study some rivulet discoloured and swollen by recent rains, and trace its windings to the river into which it falls; to follow the river as it broadens in its passage to the sea; and to watch the way in which the mud and sand carried along by the flowing waters are spread out over the estuary, in order to discover the secret of the formation of the sedimentary strata which form so large a part of the habitable globe; they are at first naturally incredulous as to whether such a vast amount of material as that which is contained in the rocks exposed in our quarries and rising above us in our mountains could have been accumulated by so simple a method.

When it is also stated that there is no warrant for imagining that the formation of hills, valleys, plains, islands, and continents in every period of the earth's history, was effected by means entirely different from those which come under our observation, inasmuch as familiarly known agencies are sufficiently potent to account for the geographical characteristics of every epoch; and when it is added that all the continents of the world would be reduced to sea level within a calculable time (should no upheaving force come to their rescue) by the showers, and storms, and frosts which are now wearing them away; and the streams and rivers which are now carrying the worn-away material, in the shape of mud, sand, and gravel, down to the sea, many men find it difficult to believe that phenomena so wonderful could result from causes apparently so slight.

What is done by one small stream, however, will show what the streams and rivers of the world are all doing. A stream in Shropshire has been experimented upon, in

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order to ascertain, accurately, the amount of sedimentary matter carried down annually. The breadth of the Omry is only about 40 feet; and its basin covers an area of not more than 84 square miles; yet at one period it was found that 2,128 lbs. of mud per minute were carried down in suspension, besides the quantity of sand and pebbles rolled along the bottom.* When the power of one very little river is known to be so tremendously destructive, the washing away of a continent by all its streams—which means the formation of new sedimentary strata, or, in other words, the deposition of new material for the making of new rocks—becomes intelligible as a process now going on. The land on which we live is at the present day being worn away, unhastingly and unrestingly, showing clearly the way in which the land has been worn away in the past.

The amount of sediment carried down by great rivers can also be estimated. American engineers have calculated that the Mississippi river carries every year into the Gulf of Mexico about 750,000,000 cubic feet of sand, earth, and gravel.

"Their observations led them to conclude that the annual discharge of water by the Mississippi is 19,500,000,000,000 cubic feet; and consequently that the weight of mud annually carried into the sea by this river must reach the sum of 812,500,000,000 pounds. Taking the total contributions of earthy matter, whether in suspension or moving along the bottom, they found them to equal a prism 268 feet in height, with a base of one square mile."†

* "Midland Naturalist," vol. ii. p. 21.

† "Text Book of Geology," by A. Geikie, p. 371.

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While a certain portion of this earthy matter is swept from the channel of the river, a very large proportion comes from the land surface of America, and has been brought into the water by contributory streams, and torn away from the banks. It will be evident, therefore, that a vast part of any continent could be destroyed by such a river as the Mississippi in the course of a million years.

Dr. Geikie has made some famous calculations, to the effect that should the present rate of the wearing away of the land surface continue, and should there be no upheaval (a process, however, which it has already been pointed out is always going on in some one district or another), the North American continent would be worn away in about four and a half million years; the British islands would be levelled in about five and a half million years, and the whole of Europe in rather less than half a million years.*

Of course it is not pretended that these figures can be exactly accurate; but it is beyond all doubt that the land on which we live is being worn away, and washed away, to an enormous extent; and this fact enables us to realize the extraordinary power of the agencies actually at work in the world.

The work done by the underground forces which manifest themselves in earthquakes and volcanoes is equally patent.

Sir C. Lyell sums up the results of only a very few of the convulsions which took place during the first half of the 19th century.

"New rocks have risen from the water; new hot

* "Text Book of Geology," by A. Geikie, p. 444.

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springs have burst out, and the temperature of others has been altered. A large tract in New Zealand has been upraised 1 to 9 feet above its former level, and another contiguous region deepened several feet, and in the same archipelago a fault or displacement of the rocks nearly 100 miles long and about 9 feet in vertical height has been produced. The coast of Chili has been thrice permanently elevated; a considerable tract in the Delta of the Indus has sunk down, and some of its shallow channels have become navigable; an adjoining part of the same district, upwards of 50 miles in length, and 16 in breadth, has been raised about 10 feet above its former level; part of the great plain of the Mississippi for a distance of 80 miles in length, by 30 in breadth, has sunk down several feet."*

In the year 1759 a stupendous series of volcanic eruptions took place in Mexico. Six cones were formed, composed of ashes and lava, the least of which was 300 feet in height, and Jorullo, the central volcano, was elevated 1,600 feet above the level of the plain.

The forces which caused catastrophes such as these during a very brief period are certainly capable of producing the vastest changes when acting, as they certainly have acted, through thousands of years.

The forces that have kept the crust of the earth in motion are still at work—causing in some districts its subsidence and in others its upheaval. Even as I write (1887) intelligence comes of a case of subsidence.

An extensive table land in the department of the Creuse (France), on which is built the village of Fourier, is found to have gradually sunk by several yards, within

* "Principles of Geology," by Sir C. Lyell, ii. 110.

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the last twenty years. The change has been unaccompanied by any earthquake, nor has there been any noticeable alteration in the character of the soil.

The coast of Siberia and the coast of Norway are gradually rising; the rate of upheaval is slow—probably about 2½ feet in a century—but a slow movement continued over 1,000 or more years would effect enormous changes.

The history of the earth's formation extends, as will presently be shown, over millions of years; and all doubt as to the capacity of the forces now in activity to cause vast changes will disappear when we multiply their observed effects by millions.

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CHAPTER III.

THE BOOK OF NATURE A MORE TRUSTWORTHY AUTHORITY THAN THE BOOK OF GENESIS.

THE proposition that the laws of Nature as ascertained by observation must be relied upon for an explanation of the method of creation is looked upon with suspicion not only by those who do not appreciate the strength and majesty of the forces now in active operation, but also by many religious people who believe that the Book of Genesis contains special information given to man by the Almighty Himself.

The word "Genesis" refers to the coming into existence—the production—the earliest development—of any thing, or species of plants or animals, or persons; and the "Book of Genesis" might be called the "Book of Origins" or the "Book of Beginnings."

The Book of Genesis describes in chapters i. and ii. the origin or the beginning of the Heaven above us, with all its stars; the earth with its seas and dry land and all the plants and animals we find in existence around us; and the human race to which we belong. In accordance with a very ancient opinion current among the Jews, its authorship is, in our Bible, ascribed to Moses; and it is entitled "The First Book of Moses called Genesis."

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The account of the creation given in the Book of Genesis is frequently called the "Word of God." The great Jewish leader and law-giver, Moses, it is very generally believed, received directly from the Creator himself an account of the way in which "the heaven and the earth" had been fashioned; and wrote down exactly what he was told, without making the slightest mistake.

Many religious men have therefore felt themselves bound to accept the statements made in Genesis as true. They have doubted the results of scientific investigations rather than the account of creation given in the Book of Genesis; and have even gone so far as to condemn, with a severity which only wickedness of heart can deserve, those who have declared that the words of an ancient Hebrew writer are of far less authority than the laws which are found, by an actual examination of the world itself to have been imposed by the Creator upon his own works.

The plain and simple question to be answered is this—Should a study of the laws of Nature show us one thing, and the Book of Genesis tell us the opposite, which ought we to believe?

The following considerations will guide us, I think, to no uncertain conclusion.

I. The Book of Genesis is composed of different documents — two accounts being given of the same transaction, both of which cannot possibly be true. Scholars attempt to distinguish between these documents by the names given to God; in some passages the name Elohim being used exclusively; in others the name Y H V H represented in our English versions by Jehovah ("the Lord") being introduced.

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One account of creation extends from chapter i. 1 to chapter ii. 3; and in this God is called Elohim; another account begins chapter ii. 4, and in this God is called Jehovah-Elohim.

The important point to be noted, however, is the wide divergency between these separate and distinct descriptions of the Creator's work.

In the first account the land is represented as emerging out of the waters (i. 9), and must, therefore, at its first appearance have been saturated with moisture; in the second the earth is described as having been too dry at its first formation for plants to grow until a mist had watered the whole face of the ground (ii. 5-6).

In the first account man is said to have been formed the very *last* of all things (i. 26); in the second, birds and beasts are alleged to have been created *after* the man (ii. 19), only plants and trees having been formed before his appearance.

In the first account man and woman are created together (i. 27); in the second the creation of "every beast of the field and every fowl of the air" *comes between* the placing the man in the Garden of Eden and the formation of a woman out of "one of his ribs" (ii. 18-22).

It is absolutely impossible that such contradictory narratives can be equally accurate.

II. No positive evidence can be found as to who was the author—or who were the authors—of the Book of Genesis when considered as a whole.

Some chapters contain allusions which prove that they must have been written after the death of Moses.

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In Gen. xxxvi. a list of Kings of Edom is given; and it is said (v. 31) "these are the Kings that reigned in the land of Edom, *before there reigned any King over the Children of Israel.*" Now, there was no King of Israel until years after Moses.

If we found in an English history the statement—"these were the Kings of England before the accession of the House of Brunswick," we should of course conclude that it must have been written after that event.

In Gen. xii. 6 it is stated Abram passed through the land unto the place of Shechem, unto the "Oak of Moreh; and the Canaanite was then in the land"—a remark which no one would make until the Canaanite had been driven out; that is, until after the time of Joshua. Were an English writer to say—"I passed through Paris when it was occupied by the German army," every one would know that this part of his book must have been composed after the Franco-German war.

Such passages as these could *not* have been written by Moses—and there is absolutely no way of discovering how much or how little that great Law-giver wrote of the book ascribed by tradition to his hand. That Moses did not write the whole of Genesis is certain; and whether or not he wrote any part of it is uncertain. The two accounts of creation must, therefore, be regarded as the production of unknown authors; and their statements are not even supported by the authority of their names.

III. No proof whatever that the writers of the Book of Genesis had any special information given them by

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the Creator is forthcoming. For themselves they make no claim of the kind; and no explanation is offered as to how they learnt what happened when "in the beginning God created the heaven and the earth."

Inasmuch, then, as the Book of Genesis contains contradictory narratives, and was composed by authors whose names are unknown, and who give no verifiable account of the way in which they obtained their information, *should its statements be found to be opposed to any fact or law of nature—the fact or law of nature must be believed in preference to them.* The facts and laws of nature are the sure and certain "word of God." *They* can be observed—tested by experiment—and put to the proof of practical application. To them must we humbly and reverently submit our minds. In their light must we seek to see the light of the Creative wisdom.

The conclusion we have reached respecting the sources of our knowledge of the method of creation may be summed up in the great words of the Apostle Paul.

"The invisible things of him since the creation of the world are clearly seen, *being perceived through the things that are made,* even his everlasting power and divinity." (Romans i. 20.)

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CHAPTER IV.

THE GREAT RELIGIOUS PRINCIPLES TAUGHT IN THE FIRST CHAPTER OF GENESIS.

THE accounts of creation contained in Genesis must not be thrust aside as worthless because they cannot be accepted as a final and deciding authority.

They are ancient legends—embodying with exquisite simplicity the first questions asked by man when he became conscious of the wonder and the glory of the world in which he found himself—but they are more than legends. They are noble poems—rhythmic alike in language and in thought; and displaying imaginative power akin to that which guided Milton through the gates of Paradise—but they are more than poems. They are the work of profoundly religious men, who, by the very might of their faith in God, were enabled to grasp certain sublime principles involved in the very constitution of the created universe, which all the discoveries of modern science have continued to illustrate and enforce. These great religious principles can be separated from the details of the history of creation with which they are associated (details which, as will presently appear, cannot be accepted as accurate), and can both naturally and conveniently be grouped together.

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Gen. i. 1. *In the beginning God created the heaven and the earth;* sun, moon, and stars, every plant and every animal, all without exception are God's.

To put this sublime principle (which underlies every other in the chapters) into other words, creation is a perfectly harmonious whole; no part exists in independence of any other part. Everything in heaven and earth is bound together in one vast system, by the power of one Creator; one Divine Life pervades all that is. When the Book of Genesis was written only a very small part of the world and a very few of the creatures inhabiting it were known, while sun, moon, and stars were merely looked upon as "lights" to rule the day and night. Its authors could not, therefore, have understood all that is involved in their words; but this does not detract from the grandeur of their faith, that all things were formed and are sustained by One Power and One Wisdom. Science enlarges the range of this thought, as it reveals day by day more and more clearly a subtle and enduring connection between every atom and every creature both in this world and in the universe. The laws with which we have to deal upon earth are the laws which prevail among the stars. Were any alteration made in the movements of worlds in the depths of space our own globe would feel the shock.

Moving bodies on earth are directed by the same forces as the planets in their courses. The physical history of our globe cannot be studied apart from problems that involve the history of every star in the sky. As completely as the body is one although it has many members, so is the universe one although it contains

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millions of worlds. All the forms of life that are now, or ever have been, are more or less directly related to each other. The humblest investigators of the lowliest forms of life are brought face to face with questions affecting the nature and the destiny of the universe itself.

Tennyson does not go beyond the warrant of the strictest facts when he writes:

> "Flower in the crannied wall,
> I pluck you out of the crannies;
> Hold you here root and all in my hand;
> Little flower! But if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is."

The old Greek word *Kosmos* primitively indicated an adornment, grace and harmony being involved in its meaning. It came to be applied to the order observed in the movements of the heavenly bodies. It is now used to denote the harmonious connection existing among all things; and in a great work entitled *Kosmos* Humboldt illustrates the principle that "Nature, considered rationally, that is, submitted to the process of thought, is . . . . . one great whole animated by the breath of life."

Gen. i. 31. *And God saw everything that he had made, and behold it was very good.*

The writer of these words may not have written chap. iii.—if he did, he could scarcely have realised the greatness of his own thought. In chap. iii. the serpent is described as tempting Eve to disobedience, and thorns and thistles are supposed to have grown when the ground had been "cursed." Yet serpents, thorns and

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thistles, as created by God, must be "good" as well as nightingales and roses; and they have played their part in the wisely ordered development of the world.

Taking the words, "and he saw everything that he had made, and behold it was very good," in their full meaning—how sublime they are and how thoroughly in accordance with the teachings of science!

Science teaches that no portion of the world is imperfectly formed; and that none of the phenomena of nature are evil.

Even great philosophers have looked upon the world as faultily formed. The Latin poet, Lucretius, who was a fearless critic of superstitious dreams and gloried in the control gained by man over natural forces, could not throw off the idea that there are many faults in nature: "For even if I were ignorant what the primary elements of things are, yet this I could venture to assert from the silence of heaven itself, and to support it from many other reasons; that the system of things was by no means prepared for us by divine power, so great is the faultiness with which it stands affected. In the first place mountains and woods, the abodes of wild beasts, rocks and great marshes, and the sea which widely separates the coasts of countries, extend over a vast portion of all that which the rapid circumvolution of the heaven covers. Moreover, burning heat and the constant descent of frost deprive mortals of almost two-thirds of what is left. And as to the land which yet remains, nature would still by her own operations cover it with thorns if human strength did not prevent. . . . . And at times when all things procured with great labour are green and flourish over the earth,

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either the sun in the heavens burns them up with violent heat, or sudden showers and cold frosts destroy them, or blasts of wind with violent hurricanes tear them to pieces."—*Lucretius, Book V.* 196 *et seq.*

Pagan worshippers—and even some Christians—have believed that the anger of an Immortal God is shown in storms and earthquakes, and in exceptional seasons of heat, or cold, or rain.

Eastern sages looked upon the material composing the earth as inherently impure, and puzzled their minds with the question how a pure spirit could create an impure world? The world was not made by the Infinite God at all, but by some powerful spirit—issuing originally from his Being, but inferior in authority and worth to himself—was the reply of many, which became the foundation of a thousand mystic schemes of philosophy.

In Europe even during the Christian epoch evil spirits were supposed to have command over the forces of nature. Witches were imagined to obtain authority over the elements by selling their souls to the devil; and chemists in their laboratories were credited with making the same unholy bargain in order to obtain a knowledge of the secrets of the universe.

Science has confirmed the truth of the grand old words that everything God has made is "very good."

The existence of inaccessible crags, sandy deserts, ice-bound seas and tropical jungles, is not due to the operation of bad natural laws or to neglect on the part of the Creator, but is the necessary result of the causes which have made earth rich in fertility for the support of man, and glorious in loveliness.

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Storms do not rise because the winds have broken loose from restraint and rush about wherever they please. They are governed by fixed regulations, and disorder would ensue were those regulations broken.

Earthquakes are in no sense signs that the world is falling into a disorderly state of ruin. On the contrary, they are as strictly the result of the established laws which secure order in nature as are the tides of the sea. The causes that produce earthquakes indeed are those that affect the upheaval of the land; and they are therefore rather preservative than destructive of the earth's crust as the abode of man.

The influence of no evil rebellious spirit can be detected in any atom of matter. Every atom of matter is in truth a very complicated structure, and the laws by which its extraordinary activities are directed are never known to fail.*

Weeds are not only as perfect after their kinds as the loveliest garden flowers, but form links in the great chain of vegetable organisms which could not have been dispensed with, without interference with the development of the trees from which we gather fruit, and the plants which yield our harvests.

The tiniest creature has its own place and function, and the laws through which it came into being are those that have at last resulted in the creation of man himself.

* By the term *atom* must be understood the least part of a so-called "element," which possesses the properties of the element. It does not now signify indivisibility, but only that, so far, it has not been divided. Many chemists suppose that these atoms may be resolved into still simpler structures. That they are complex is indicated by many of their physical properties.

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Genesis i. 26–27. *And God said, Let us make man in our image, after our likeness; and let them have dominion over the fish of the sea and over the fowl of the air, and over the cattle and over all the earth; and over every creeping thing that creepeth upon the earth.*

And God created man in his own image, in the image of God created he him; male and female created he them.

Whether man was made the very last of all creatures, as is asserted in Genesis, is uncertain.

That man lived when many animals now extinct dwelt upon earth cannot be doubted. I shall have occasion to give the proof of this fact presently; it is enough now to state that human remains are found so closely and constantly associated with the bones of extinct animals that their co-existence is placed beyond question. Man lived even in England when huge elephants of extinct species wandered through its ancient forests from north to south; when an extinct species of rhinoceros wallowed in the rivers of Yorkshire; and when the extinct sabre-toothed tiger hunted its prey in Devonshire. It is possible, and not at all improbable, that some species or other of bird, fish, or beast, came into the world subsequently to man's first appearance, if not in England, at any rate in the East.

Be this as it may, the position assigned to man in Genesis, as the greatest of "living creatures" on earth, cannot be challenged.

Science offers ample evidence that man's place in nature is the highest; and the more closely his endowments are studied, the more clearly they are seen to connect his life with the spirit of his Creator.

Man is manifestly the world's master. No wild ani-

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mals, with all their fierceness, strength, and cunning, can hold their own against man; he can drive them out of any district he desires to conquer. He can support himself under severer extremities of heat and cold than any other single race of creatures can manage to endure. It is true that when compared with many other animals man appears to be far more helpless than they are. His body is naked and unprotected either by a thick skin or horny plates; he cannot discover food or detect danger by smell; his speed of foot is slight, and his physical strength small; he has no great teeth, sharp claws, or poisoned fangs for defence. But, as Darwin points out:

"The small strength and speed of man, his want of natural weapons, &c., are more than counterbalanced, firstly, by his intellectual powers, through which he has formed for himself weapons, tools, &c., though still remaining in a barbarous state; and, secondly, by his social qualities, which lead him to give and receive aid from his fellowmen. No country in the world abounds in a greater degree with dangerous beasts than Southern Africa; no country presents more physical hardships than the Arctic Regions; yet one of the puniest of races, that of the Bushmen, maintains itself in Southern Africa, as do the dwarfed Esquimaux in the Arctic Regions."*

Man—it is asserted in Genesis—was created "in the image of God." Guided by the knowledge acquired by man during subsequent ages, one side of this sublime principle may be stated in the following way— man possesses the same kind of mind as the Great Spirit by

* "The Descent of Man," p. 64.

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whom he was created, just as the child possesses the same kind of mind as its father. The child may be far cleverer or less clever than its father, but it has a human mind; man must be infinitely inferior to his Creator, yet his mind is God-like in its qualities.

One great proof of this is to be found in the fact that by the independent exercise of his own faculties man has arrived, and is constantly arriving, at results precisely similar to those involved in the laws of nature. I borrow one or two illustrations in explanation of this statement.*

A challenge was once given to the mathematicians of Europe to determine the line of swiftest descent of falling bodies. The problem was solved by two great men, purely by mathematical calculations. It is not the straight line, but a particular curve, called the cycloid. Now this very curve is described by the eagle when it sweeps down upon the prey. The Creator who fashioned the eagle for flight must, therefore, have given man powers of thought similar in character to his own.

Ancient geometers studied the properties of the oval curve called the ellipse, simply for the purpose of gaining knowledge. They made no particular use of the propositions they established, but preserved them in mathematical books.

Many years afterwards it was discovered by the astronomer Kepler that the planets travel in oval or elliptical orbits; and the old calculations enabled many questions regarding their movements to be answered. The mind

* *See* "Typical Forms and Special Ends in Creation," by Dr. J. M'Cosh and Dr. G. Dickie.

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of man must be like the mind of the Creator, or man could never have found out of his own accord the laws enforced among the stars, long before the facts themselves had been ascertained by observation.

There is the same kind of correspondence between the moral judgments that are actually enforced by pains and blessings, in the government of individuals and nations by the Creator, and the verdicts given by the consciences of educated and civilized men.

Moral as well as physical laws are established in the world. All our feelings, passions, and actions produce their own distinct fruits—precisely like the seeds sown in the garden, each after its kind. What we sow that we must reap. The consequences of our thoughts and deeds are as firmly determined by the Creator as are the courses of the stars.

Intemperance and unchastity, falsehood and dishonesty, pride and envy, hatred and revenge, produce personal wretchedness and social disorder.

We have within us what is termed "conscience,"—a faculty for recognizing the awful distinction between right and wrong. The actions which the Creator punishes are the actions which are rebuked by the conscience within us. In the words of Genesis: "God has created man in his own image." Whatever God treats as sinful and makes a source of misery, as He carries on the government of the world, man's conscience, sooner or later, condemns as shameful. The voice within is in accord with the judgments executed by the Lord of all.

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CHAPTER V.

THE CONDITION OF THE WORLD AT ITS FIRST FORMATION.

In what condition was the world when it first appeared in a distinct form, in the sky? Do we know what was its very earliest history—before the period of which the record is preserved in the oldest rocks?

The sciences of astronomy, physics, and chemistry are gradually throwing light upon this subject; but, at present, there is too much uncertainty on the whole matter to justify any positive statements. The substance of a very probable theory respecting the first formation of the earth, as a distinct star, scarcely admits of accurate statement in an elementary form.* The following description of it by Professor Green is, perhaps, the clearest that can be given:

"There are in the heavens faintly luminous cloudy masses, known as nebulæ; and the spectroscope has lately revealed to us the fact that some of these are bodies of glowing hot gas, and the appearance of some of them is such as would be produced by rotation round an axis.

"As the heat escapes from these by radiation into

* Another speculation recently advanced on very eminent authority, is that the earth has gradually grown up through an accumulation of meteorites.

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space they must contract; whenever from time to time the shrinking has gone so far that the central attraction is no longer able to overcome the tendency of the outside portion to fly off, a ring is separated, which afterwards collects together into a ball. By a continuation of this process the nebula is, at last, broken up into a number of balls, all of which revolve round the centre of the original mass and rotate on their axes in the same direction, and a central globe, which retains its heat after the balls have parted with a large portion of theirs. In a word, the nebula is in this way transformed into a group of planets revolving around a central sun. The theory which supposes the solar system to have originated in the manner just sketched out accounts so satisfactorily for many of the main characteristics of the planetary system that there is a very strong probability of its being true. But for details on this head, the reader must turn to works on astronomy; we have to do with the theory here, only so far as it concerns the earth. According to it our globe was originally an intensely heated, rotating mass of gas, and has assumed its present form by gradual cooling."*

I. Whether this theory be correct or not it must not be imagined that there was at any time in the earth's history a chaos, or a state of utter confusion. Laws prevail among all the elements so persistently and universally that whether they originally combined in gaseous, liquid, or solid forms, a divine order must have been established; a perfect and complete harmony must have prevailed.

* "Geology for Students," by A. H. Green, M.A., Part I. p. 479.

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The inference naturally to be drawn from the words used in Genesis, "and the earth was waste (without form) and void, and darkness was upon the face of the deep," is that the writer believed that the world in the beginning was in the state of chaotic confusion: and that God interfered and substituted order for disorder. Milton has largely assisted in securing a widely spread credence for this interpretation—he describes "the King of Glory"

> "in his powerful Word
> And Spirit coming to create new worlds."

And viewing

> "the vast immeasurable abyss
> Outrageous as a sea, dark, wasteful, wild,
> Up from the bottom turned by furious winds
> And surging waves, as mountains, to assault
> Heaven's height, and with the centre mix the pole.
> "Silence, ye troubled waves, and thou deep, peace,"
> Said then the omnific Word, "your discord end,"
> Nor stay'd; but on the wings of cherubim
> Uplifted, in paternal glory rode
> Far into Chaos."

Into matter, "unformed and void," the Spirit of God then infused "vital virtue," but

> "downward purged
> The black, tartareous, cold, infernal dregs,
> Adverse to life."
>
> —*Paradise Lost, Book VII.*

This extraordinary and fanciful idea that the world was at first a mass of unregulated chaotic material is repeated in an invocation, contained in a well-known hymn, to the

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> "Great Spirit, who along
> The waters first did move
> And straight *from warring chaos* sprung
> Light, harmony, and love."

How far the words "without form and void" imply absolute confusion is a matter of some controversy. They mean literally wasteness and emptiness, and are employed by Jeremiah to picture the condition of a country smitten with desolation by the hand of the Lord because of its wickedness (iv. 22–26).

Whether or not, however, the writer intended to describe the original condition of the earth as completely chaotic, the words that "the earth was without form and void" do not clearly indicate the divine order which must have prevailed among the elements at the very earliest, as at the latest, stage of its development.

II. In Genesis water is selected as the material upon which the Creator acted in the first instance—"and the spirit of God moved upon the face of the waters." (i. 2.)

Now that science has shown that there are many "elements"—substances, that is, which cannot as yet be resolved into any other substances, and by their various combinations form all known things—it is difficult for us to understand the way in which in olden times men speculated about what were called "the elements," viz., fire, air, earth, and water.

An account of an ancient Greek philosopher, Thales, who was born about 640 B.C., may render intelligible how this verse of Genesis came to be written—and also ii. 6.

"Thales felt that there was a vital question to be

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answered relative to the beginning. He looked around him. On what he saw he meditated; the result of his meditation was the conviction that moisture was the beginning . . . Once impressed with this idea, he examined the constitution of the earth. He found moisture everywhere. All things he found nourished by moisture; warmth itself he declared to proceed from moisture; the seeds of all things are moist. Thus convinced of the universal presence of water, he declared it to be the beginning of things. Just what moisture is to the ground, it has well been said, necessary to its being what it is, yet not being the ground itself, just such a thing did Thales find in himself, something which was not his body, but without which his body would not be what it is; without which it would be a dry husk falling to pieces."*

Whatever the primitive condition of the earth it could not have been a mass of water. Water in chief part consists of two gases only—oxygen and hydrogen—and does not contain all the varied elements composing the crust of the globe. Neither could the material of which rocks are fashioned have been altogether covered by water, when it was originally massed together, since many facts tend to show that it existed in a molten or extremely heated form, upon which water could not rest until a long period of cooling had elapsed.

To avoid these difficulties it has been suggested that the word "deep" means merely vapour in the atmosphere; and the word "waters" a fluid mass; so that the text only states that when God created the earth it

* "Biographical Hist. of Philosophy," by G. H. Lewis, vol. i. chap. I.

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was in an intensely heated or gaseous state. But we have no right to put our own notions into the Book of Genesis. Our duty is to learn the author's own meaning. He explains the very rare old word translated "deep" (*t'hom*) by the word "waters"; and we must believe that when he uses the word "waters" he is really speaking of water, and of nothing else. He must, therefore, have supposed that the beginning of all things was a vast watery mass, amid which the heavens and the earth were created.

III. Genesis further tells us that Light was created by itself on the first day, and before the sun, moon, and stars, which are referred to the fourth day (i. 3–5; 14–19).

Regarding these passages the following points must be noted:

(1) The various forces of Nature—or, more properly speaking, forms of energy—such as Light, Heat, Magnetism, Electricity, &c., are so intimately connected together that no one of them can be fixed upon as the first in the order of creation. One form of energy can be transformed into another, as heat into motion; and when one is excited many others are set in action.

There is as much reason for saying that the first word of the Creator was "Let there be motion," or "Let there be heat," or "Let there be electricity," or "Let there be chemical action," or "Let there be magnetism" —as that his first word was "Let there be light."*

* It is impossible to give a full account of the grounds on which this statement is made, without entering into explanations of the modern doctrine of "Energy," which would require far more space than can be afforded in this book.

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(2) The writer of Genesis regards the sun, moon, and stars as merely appendages to this earth—and created for its service only; their sole office being "to give light,"—to divide day from night—to determine the seasons. He could not have regarded the heavenly bodies as entirely subordinate to the earth—had he known that the Sun is one million four hundred thousand times the larger body; and that many of the stars are themselves suns and the centres of revolving worlds.

(3) The sun could not have been created after the earth was clothed with vegetation, since the reeds and rushes, ferns, flowering plants, and vast forests, which are found imbedded in the rocks in abundance, present every sign of having flourished beneath its light and heat under conditions similar to those which now prevail.

Fossil plants occur in many ancient formations in every stage of growth, with bark, leaves, fruit or cones, as the case may be, alike in a state of decay and in vigorous growth; and their structure is as indicative of the presence of the sun in the sky, and the succession of changing seasons caused by the revolution of the earth in its orbit, as the structure of the familiar grasses, herbs, and trees of our own fields.

The reader is referred to an admirable manual on "Energy in Nature," by Wm. Lant Carpenter.

I subjoin an extract from Sir W. Grove's "Correlation and Continuity," given by Mr. Carpenter.

"Tracing any force backwards to its antecedents we are merged in an infinity of changing forms of force; at some points we lose it, not because it has in fact been created at any one point, but because it resolves itself into so many contributing forces that the evidence of it is lost to our senses or powers of perception."

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(4) That this earth was the very first star in the sky is an incredible supposition. A number of planets are connected with the system to which it belongs and revolve in company with it around the sun, so that it cannot have been formed quite independently either of their movements or of the sun—the central source of its and their light and heat. This earth, moreover, is but one of the least among at least 75,000,000 stars, and is not in any sense the centre of the universe.

Amidst these millions of stars there are no grounds whatever for fixing upon so dependent and so small a body as the earth, as having been formed "at the beginning."

Proctor sums up as follows the general results of astronomical researches:—

"The sidereal system is altogether more complicated and more varied in structure than has hitherto been supposed; in the same region of stellar depths co-exist stars of many orders of real magnitude; all orders of nebulæ, gaseous or planetary, ring-formed, elliptical and spiral, exist within the limits of the galaxy; and lastly, the whole system is alive with movements, the laws of which may one day be recognized, though at present they appear too complex to be understood."

The remains of extinct stars are also (according to Mr. Proctor) detected—stars which were probably once as bright as our own sun, but are now dark and cold.

IV. The first act of the Creator having direct reference to the earth is described in Genesis as having been the formation of what is called a "firmament in the midst of the waters;" and the division of the waters by its means into two portions, one portion

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being placed "above" and the other remaining "under" it.

Genesis i. 6–8: *And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters. And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament; and it was so. And God called the firmament Heaven.*

To understand this passage it must be recollected that "in the beginning" the world was supposed to have been nothing but a "deep," a confused mass of "waters," and that neither sun, moon, nor stars had been called into existence. It occurred to the ancient thinker, therefore, as he speculated on the origin of things, that before anything else could have been accomplished a roof must have been spread out over the earth, and some of the waters have been taken away. He imagines, in order to meet this difficulty, that an expanse of material substance was made in the very midst of the waters, in the shape of a vault.

This is the "firmament" or "heaven," or the overarching sky beneath which we live. The Hebrew word translated "firmament" means literally an expanse, and is derived from a word signifying *to beat out.*

This "firmament," heaven, or sky, is described as having been sufficiently strong to support the mass of waters which, since it was formed in their very midst, would rest upon it; as dividing the "waters from the waters;" and as being arched like a dome—as our sky appears to be. It is evidently thought that a clear space would be secured by its aid between the waters ultimately to be confined within the boun-

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daries of rivers, lochs, and seas, and the waters kept in store above its expanse.

This idea, that waters are preserved above the visible sky, is found in the Psalms, where "the waters that be above the heavens" are called upon to praise the name of their Lord.

"Praise him, ye heavens of heavens, and ye waters that be above the heavens." (Psalm cxlviii. 4.)

Colenso points out that it also occurs in the Indian mythology, and quotes the following words from one of the sacred books of the East:—

"Water is above the Heaven, which the Heaven sustains." (Colenso on the Pentateuch, part iv. p. 98.)

Several passages in the Old Testament show that the Hebrews regarded rain as the dropping down upon earth of the waters retained "above the firmament."

The flood is said to have been caused by the opening of "the windows of heaven" (Genesis vii. 11); and to have been restrained by their closing (Genesis viii. 2).

Although these expressions regarding "doors" and "windows" in the heavens may be taken as to a certain extent poetical, the fact remains that the writer in Genesis regards the sky which we now know to be a boundless extension of space, as a fixed and firm roof supporting a mass of water by its own inherent strength.

On the whole, therefore, it appears that the difficult task of discovering what the planet we inhabit was at the very beginning, and by what processes it was made an orbed world at all, must be left in the hands of scientific men, and that the account given in Genesis cannot be permitted to hamper their investigations,

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since in many points it is at variance with well-established discoveries.

The very fact, however, that men in those early ages sought to fathom the secrets of creation is a wonderful revelation of the richness and the glory of their intellectual endowments. Their speculations may have been, as they were, strange and incredible, but their power of speculating upon such majestic subjects itself shows how far they were uplifted above "cattle and creeping things and beasts of the earth."

That they were unable to rest in peace, contented with ignorance; that they were compelled by the irresistible demands of their nature to ask questions about everything in the earth beneath and the heavens above; that they earnestly endeavoured to observe, to learn, and to think, is a sublime proof of their nearness to the spirit of their Maker. New discoveries have shown the errors at the base of ancient theories; but modern men of science are bound to honour as their brethren those who, standing nearer to the dawn of time, felt the awful mystery of creation and sought for truth, although they were unable to gain any accurate knowledge of those great laws, guiding the physical universe, which even now, after the intellectual toils of many generations, are but partially understood.

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CHAPTER VI.

HOW "DRY LAND" WAS FORMED.

How was the dry land formed? How were those Rock-masses which constitute our plains, valleys, and mountains placed in their present position?

Patent facts prove beyond the shadow of a doubt that the creation of our dry land was neither a sudden act nor a succession of separate, independent, and isolated acts, but resulted from a series of continuous processes extending in their operation over a vast series of ages.

Every acre of soil, every drifting heap of sand, every bed of pebbles or of clay, every fragment of stone, every mass of rock, was not suddenly made just as it is, and put down, immediately on its formation, in the exact spot at which we find it, but has had a long and wonderful history.

I.

Rocks have been formed by various agencies.

1. *Rocks have been formed by the action of water.*

Streams, rivers, and seas, have washed into sand and gravel the cliffs by which they have been bounded, the banks between which they have flowed, and the beds over which they have swept. These sands and gravels have been deposited layers upon layers, as the surface

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of the earth has sunk down until great masses of them have been accumulated. When the earth has been uplifted, these masses, having been compactly pressed together by their own weight, and drained of water by rising above the sea-level, have become portions of the solid rocks of the present earth. Some of them are composed of grains of sand as fine as those now seen at ebb tide upon the shore; others have water-rolled pebbles intermixed with the fine sand; others contain beds of hardened mud and silt. The remains of marine animals of all descriptions are frequently scattered abundantly through them, proving, beyond the possibility of questioning, that they originated in the manner described.

2. *Rocks have been formed by the agency of plants and animals.*

Some rocks, such as those forming our coal beds, are largely composed of the remains of ancient forests.

Many rocks have been almost entirely the work of marine animals. The lime contained in sea water has been secreted by them, to form their shells or places of abode; and as generations after generations have died, these dwelling-houses which they fashioned for themselves have been massed together, and a solid limestone rock has been thus created.

Some "limestones" are found which consist of coral; others are largely composed of the stems of encrinites—creatures which belonged to the same great division of invertebrate animals as our star-fish and sea-urchins. The South Downs of England—which are masses of chalk—contain such countless millions of the minute

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shells of foraminifera,* that they may practically be said to have been built up by the labours of those almost microscopic animals.

3. *Rocks have been formed by chemical agencies.*

Carbonate of magnesia has been combined with carbonate of lime in some rock masses, producing what is called "Magnesian Limestone," of which great beds occur in the north of England; beds of gypsum have been formed from the decomposition of other rocks; masses of rock-salt have been deposited by the simple evaporation of extremely brackish water.

4. *Rocks have been formed by volcanoes.*

During every known period of the earth's history, volcanoes have been at work; and have poured forth sheets of lava, which have covered enormous areas.

In Great Britain—as in every other part of the world—active volcanoes have existed during many periods.

Sheets of lava have been intruded between other rocks; they sometimes stand out distinctly as bosses and hills; and even rise to the height of mountains. Streams or veins of molten lava have been poured into the rents and fissures of solid rocks, or have forced their way through them when they have been able to obtain an entrance; and on cooling have become hard and compact—forming what are called "dykes." Sometimes, as on the coast between Crinan and Oban in Scotland, these "dykes" may be seen standing up like

* *Foraminifera*—one of the lowest classes of animals, having a jelly-like body from which fine threads are sent out and drawn back for taking hold of any object; and having a shell composed of lime or grains of sand, generally with minute holes, through which the threads are extended, and divided into chambers.

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walls—the rocks into the midst of which the lava flowed having decayed away.

Speaking of the molten lava rock which at one period only rose up from below, filling up vast fissures in the earth's crust, eastward across Scotland and the north of England, and which is now seen in the shape of dykes, Dr. Geikie writes:

"When we reflect that this system of dykes can be traced from the Orkney Islands southwards into Yorkshire, and across Britain from sea to sea, over a total area of probably not less than 100,000 square miles, we can, in some measure, appreciate the volume of molten basalt which in Miocene times* underlay large tracts of the site of the British Islands, rose up in so many thousands of fissures and poured forth over so wide an area in the North West."†

Not only did the lava rise up through fissures, but it was poured out in successive sheets.

"The plateaux of Antrim, Mull, Skye, and adjacent islands are composed of successive outpourings of basalt, which are prolonged through the Faroe Islands into Iceland, and even far up into Arctic Greenland. In Ireland the basalts‡ attain a thickness of 900 ft.; in Mull, about 3,000 ft."§

When it is remembered that every successive period of the earth's history has its own tale of volcanic activity

* *Miocene times*—one of the later periods in the earth's history. *See* the "Table," p. 96.

† "Text-book of Geology," p. 258.

‡ Ibid, p. 258.

§ *Basalt*—a series of comparatively heavy, dark-coloured rocks of volcanic origin.

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to tell, the part played by volcanoes in the formation of our "dry land" will be understood.

Not only have rocks been formed by these varied agencies, but a considerable number of them have been largely altered since their first deposition.

The composition and structure of many rocks have been changed, both before and after they have become —and during the very act of their becoming—the continents and islands of our world.

What is called "metamorphism"—or the alteration of the original condition of rocks—has taken place. The material originally deposited has been subjected to great pressure in every direction, both on account of its own mass and through the frequent movements of the crust of the earth. Heat has been generated; gases have been liberated; hot vapours have penetrated into the very substance of rock masses; fissures, crevices, and hollows, large and minute, have been filled with water raised to a high temperature; chemical action has set in; crystallization and recrystallization have been effected.

Sandstones, in the first instance nothing but an accumulation of the sands of the sea, have been converted into hard crystalline quartzites.

Limestones have been changed into marble.

Beds of clay have been made into slate.

II.

NOT only were our rocks *not* made all at once, and by one act of creative energy, but there has been no single period at which any distinct kind of rocks has been specially produced.

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When the fact that *rocks represent processes* is mastered, it will at once be seen that many of these processes must have been going on in every epoch; and that in every epoch, therefore, many of the same kinds of rocks must have been created.

Coal was not, for instance, made, once for all, a sufficient quantity having been provided and left for the subsequent use of man. Although a vast amount of coal is found in the beds belonging to what is termed the carboniferous epoch, all the coal in the world does not belong to that epoch. Seams of coal have been discovered among rocks which must have been formed at periods separated from each other by millions of years. Whenever the conditions essential for the formation of coal have existed, such as the presence of great forests connected with marshes, lagoons, and rivers, into which decaying trees could fall on a descending area of the earth's surface, so that their trunks would be heaped together as one forest succeeded another—coal has been made.

There was no special age in which limestone was produced, and then its formation stopped as no longer necessary. During every epoch the animals in the sea have secreted its lime for their shells and bones, and dying, have left a deposit of lime as their contribution towards the formation of the rocks of the future, when the bottom of the sea should become—as it so often has become—dry land.

From very early ages coral-building animals have constructed their reefs in the oceans, as they busily do today; and our "coralline limestone rocks" are the monuments of their history during many successive epochs.

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Neither were streams of lava poured over the surface of the world at any one time alone.

The number of volcanoes—their positions—and the violence of their activities—have varied from age to age; but volcanoes have existed in every great epoch, and the very ashes they have discharged in showers have been consolidated and have added to our dry land.

Even the processes by which the original condition of rocks has been changed are always to some extent going on. Some of the comparatively recent, as well as the more ancient sandstones, limestones, and muds, have been transformed into quartzite, marble, and slate.

III.

THE crust of the earth must be distinguished from its interior. Whether the interior of the earth is solid or rigid, or molten or liquid, is a question under debate; but the nature of its "outside rind" or "crust" is known by observation.

The crust of the earth consists of rocks laid one upon the other in an ordered succession. Masses of rock, formed by aqueous, igneous, organic, and chemical agencies, are followed by other masses, formed by one or other of the same agencies.

They are actually to be seen placed one over the other in layers showing clearly that the lower beds were created before the higher. The rocks formed by the agency of water are not all found together in one layer —the rocks formed by the lava formed from volcanoes in another—the rocks formed by plants and animals in another—the chemically formed rocks in another; but

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vast groups of rocks produced by all these different agencies succeed each other.

Rocks of all descriptions can therefore be classified according to age.

There are older and younger sandstones, older and younger limestones, older and younger calcareous beds, older and younger metamorphic rocks. Each great group of rocks, belonging to the same period, constitutes what is termed a "formation."

It has been further discovered that every formation contains the remains of plants and animals peculiar to itself.

Of the succession of plants and animals by which this earth has been inhabited I shall speak presently. At this stage of the argument it is sufficient to note that although some genera and species of plants and animals flourished during a longer period than others, yet that as one group of rocks was placed above another group the plants and animals inhabiting the lands and seas they represent were changed. From the earliest until the latest period new organic forms have constantly been coming into existence, and dying out, with greater or less rapidity, while the process of rock formation has actually been going on.

Tables showing the succession of the rocks constituting the earth's crust, and of the organisms by which land and sea have been peopled in the successive ages during which those rocks were deposited, have been constructed. Geological books must be consulted for their details, but the following are their main divisions.

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I.

Palæozoic (ancient life) or Primary Period.

II.

Mesozoic (middle life) or Secondary Period.

III.

Cainozoic (recent life) or Tertiary Period.

IV.

Post-Tertiary Period;

i.e. the period immediately preceding and including the age of man.

Each of these periods is characterized by certain plants and animals peculiar to itself.

The plants and animals of the "recent life" (Cainozoic) period are far more closely related to those of the "middle life" (Mesozoic) than they are to those of the "ancient life" (Palæozoic) period—from which indeed they are very distinct.

The plants and animals of the "middle life" (Mesozoic) period are related both to those of the "ancient life" (Palæozoic) and to those of the "recent life" (Cainozoic) period.

The plants and animals of the "ancient life" (Palæozoic) period vary the most completely from any now existing.

Although the Tertiary period is called Cainozoic, *i.e.*, the period of recent life, many plants and animals then lived which have now disappeared; but the greater part

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of those which inhabit the world with man came into existence during its course. In the Post-Tertiary period some animals which are now extinct lived after the creation of man.

These divisions, however, do not imply the existence of any sharp dividing lines in nature. Period has gradually passed into period. One set of plants and animals was not created during one epoch and then swept away, to make room for the next, any more than all the inhabitants of a town are doomed to die on one day, in order that another generation may take their place.

In a city one man dies in a ripe old age, another in his youth; one family quickly disappears and another retains living representatives, it may be for a century, but in time the whole population is changed. As gradually have the inhabitants of land and air and sea disappeared.

Among the plants and animals which flourished so abundantly as to be characteristic of one epoch, are found species which come to their full development in the epoch immediately succeeding.

The rocks also present unmistakable evidence that they were deposited formation above formation, in a very gradual way. They are not wrapped the one set over the other set, like the coats of an onion, without connection with each other, as though each set were a separate, distinct, and independent creation; but on the contrary they frequently dove-tail into each other; and there are numerous beds between series and series, which are termed "passage beds," because they contain the remains of animals which were beginning to come

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into the world intermixed with the remains of those that were dying out.

IV.

THE various rock-formations, constituting the crust of the earth, have succeeded each other in a definite and invariable order.

In no part of the world have rocks with imbedded plants and animals belonging to the Tertiary or Cainozoic system been created *before* the rocks with imbedded plants and animals belonging to the Secondary or Mesozoic system; and in no part of the world have rocks with imbedded plants and animals belonging to the Secondary or Mesozoic system been created *before* the rocks with imbedded plants and animals belonging to the Primary or Palæozoic system.

This fact has been ascertained by direct observation—it is indeed a fact as certain as that the roof of a house was not made before its upper story, and the upper story not built before the lower.

Two points, however, have to be carefully noted in connection with this unvarying order of succession.

1st. Vast masses of rock have been washed away.

Owing to the sinking of the land beneath the sea, and its upheaval (movements of which I have already spoken as occurring epoch after epoch), it has been freely exposed to the wear and tear of the waves. By the changes in physical geography brought about by these movements, rivulets, streams, and rivers have been distributed over districts from which they are now absent. Rain has also perpetually been engaged in its destructive work.

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The extent to which the washing away of the earth's crust (denudation) has taken place may be judged from an example taken from one period only.

The beds of clay and sand in the Weald of Kent and Sussex are 1,800 ft. in thickness; they contain terrestrial plants, fresh-water shells, together with the bones of huge reptiles, and represent the delta of a great river, which must have been not less than 20,000 square miles in area.

The enormous amount of sediment brought down by the river of which this delta was the termination is a measure of the destruction it worked upon the land, in the districts through which it flowed.

Subsequently—but during the same epoch—the whole of the Weald sank beneath the sea and was covered with chalk—chiefly through the labours (as has before been shown) of small foraminifera secreting the lime contained in the sea to make their shells.* Of this chalk our South Downs are the fragmentary remains—the mass of it, covering hundreds of square miles and several hundred feet in thickness, has been swept entirely away.

Our existing mountain ranges give evidence, also, of enormous denudation. Prof. Judd declares that it is impossible to overestimate the effects of the several denudations to which Scandinavia and the N. Highlands have been successively subjected.

"In the west of Scotland a chain of volcanic mountains, with summits towering to the height of from ten to fifteen thousand feet, have been reduced by this same denudation to basal-wrecks, the highest portions of which

* Chalk is carbonate of lime. About foraminifera, *see* p. 66.

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attain to but little more than 3,000 ft. above the sea-level. . . The Torridon sandstone (a rock mass in the N.W. of Scotland) is the monument, and a very striking monument, too, of another and still earlier period of denudation. The thousands of feet of conglomerate and sandstone of which it is made up consist of the disintegrated crystals of granites and gneisses that have been swept away. When we penetrate towards the axis of this eroded mountain chain the proof of the magnitude of these denudations becomes even more striking and impressive. Here we see, towering aloft, the ruined buttresses of vast rocky arches that when complete must have risen miles above the present surface; there we find lying side by side rock masses that could only have been brought together by displacements of tens of thousands of feet; yet so complete has been the planing down of the surface since that it requires the most careful study even to detect the almost obliterated traces of these grand movements. The Alps and the Himalayas, during the elevation, have suffered enormous waste and denudation; but if the elevation were to cease, and the waste to go on till these magnificent mountain chains were reduced to masses of diminutive peaks, ranging from 2,000 to 8,000 feet in height, we should then have the counterpart of this stupendous ruin of the mountain chain of the north."*

As a consequence of the denudation to which the crust of the earth has been exposed, during every epoch, many rocks are not found where they would otherwise have occurred in the natural order of succession.

* Address to the Geological Section of the British Association—Aberdeen, 1885.

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Rocks separated by a great gap of time will therefore often be seen resting upon each other—the intervening formations having been locally destroyed.

2nd. Many rocks are not now found in the horizontal position in which they were originally deposited. Although in the first instance spread out in flat layers, like sand upon the seashore, in many instances they have become mountain heights.

In some cases, a mass of old rock has been pushed through newer deposits, which may be seen inclined at a high angle, and resting against its slopes.

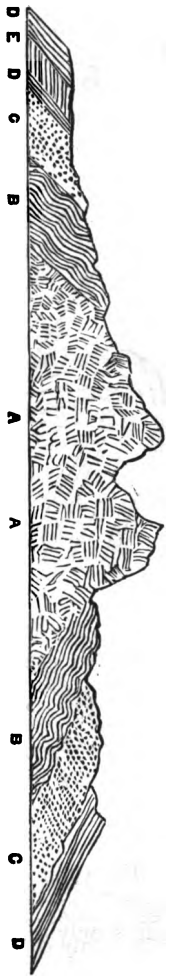
The mountain of Goatfell, in the Isle of Arran, *e.g.*, consists of a mass of granite, against the sides of which beds of slate, red sandstone, and carboniferous sandstone are uptilted. These beds were evidently at one time horizontal and continuous; and the granite has been thrust through them, aiding in uplifting and separating them.

A A granite.

B B slate with granite veins.

C C red sandstone.

D D D carboniferous sandstone with beds of limestone (E).



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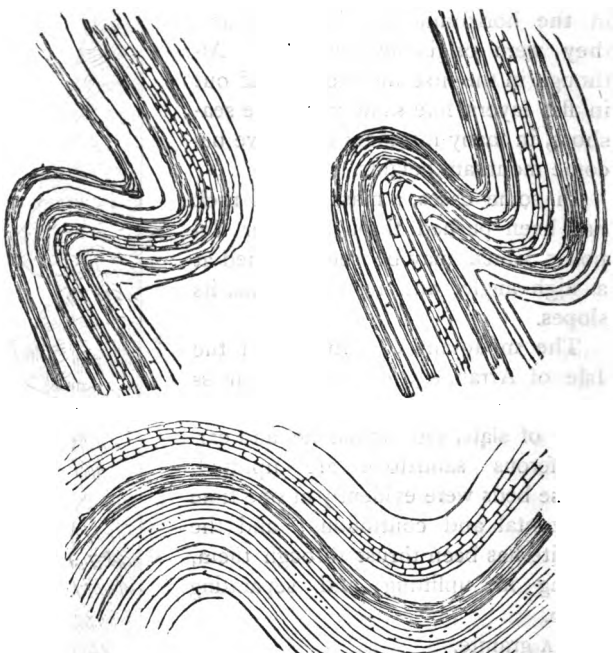
Some rocks are bent into curves—the upward bend forming an arch, and the downward bend a trough.

An S-shaped fold is sometimes produced. The sub-joined are types of "inverted fold" found among the strata of some mountains.



The summit of the arch of the curves has frequently been swept away—leaving, in a mountain range, the edges only of the bent beds of rock. The twistings and

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bendings of the strata in some mountainous regions are very complicated. Writing of the Durness-Eriboll district of the Highlands of Scotland, Dr. C. Lapworth states that the process of rock-folding in this district is exceedingly complex, and has resulted in most remarkable phenomena. The rock-folds are of all grades, from miles across down to microscopic. In some places the original dividing plane of two successive rock-sheets has been twisted into the forms of spirals, cornucopias, &c. Folding, interfolding, stretching, have also taken place again and again along the junction plane between the younger sedimentary and the older crystalline rocks.*

The causes of the movements to which vast rock masses have been subjected, and which have resulted in the making of mountains, cannot be described with any simplicity even so far as they are already surmised. All that can be stated here is, that they are due to pressure, possibly originated by the contraction of the earth's crust during the long periods in which it has been gradually cooling down and losing the heat it possessed when it first became a solid body.

During the cooling of a heated globe wrinkles would be formed, while folding and crumpling of its rock-masses would take place. But however caused, so extraordinary has been the pressure as a matter of fact, that Dr. Lapworth states that even granites and many of the very hardest rocks have been crushed to powder and finally flattened out; and Dr. A. Geikie informs us that the studies of the surveyors in North-west Sutherland lead to the conclusion that certain masses of rock

* *See* some remarkable papers by Dr. C. Lapworth in the "Geological Magazine." 1883—1885.

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have been forced almost horizontally over others, for a distance of at least ten miles.

The facts now briefly described throw a striking light upon the method of creation.

Although rock-masses have been made in successive epochs, they are not now always found resting upon each other in the order in which they were first formed. They have been subjected to many movements, in the course of which they have been thrust against and over each other; rocks of different ages have been brought into juxtaposition; and mountain ranges have been upbuilt.

V.

THE formation of "dry land," having been effected by processes so varied, so complicated, and so continuous, must have been going on during countless ages.

The rocks forming the dry land of Great Britain—that is, all those rocks which have been formed by the agency of water, by the agency of plants and animals, by chemical agency, and by the agency of volcanoes—have a maximum thickness of about 100,000 feet, or 20 miles. They are not found in a complete series, in any one place; but the stratified rocks which belong to the various formations would attain that thickness if piled one upon another. The sedimentary rocks of one epoch are largely formed by the partial washing down and wearing away of the sedimentary rocks of previous epochs, and the total thickness of all of them that have ever been formed must have therefore been vastly more than 100,000 feet.

Streams, rivers, and seas lay down thin deposits slowly,

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inch by inch; plants and animals require time for their decay and growth; and the movements of the earth's crust, as a rule, take place gradually.

When in a coal field, like that of Nova Scotia, the remains of seventeen forests are found, at distinct levels, one above the other, through a vertical thickness of 4,515 feet of strata, it is clear that no brief measure of time could have sufficed for the production of even these few thousands of feet of "dry land."

At the Spout of Ballagan, in the Campsie Hills, Scotland, 230 separate beds of limestone, sandstone, and marly shale are seen lying, one upon the other, tier on tier, in a slightly inclined position, and capped by beds of sandstone and volcanic ash. Upon some of these sandstones the very ripples of the waves of the sea, under which they were deposited, can be detected; and the thickness of the series is not less than 1,000 feet.

It is impossible to resist the conclusion that even this 1,000 feet of rock represents a vast period of time.

The changes from sea to river, from river to sea, from sea to land, have in many districts occurred with extraordinary frequency.

The following table shows the changes of medium in which the strata of some English beds were formed between two periods only—the "Oolitic" and "Cretaceous"*—

Marine.	Fresh water.
Fresh water.	Land (dirt bed).
Land.	Brackish.
Fresh water.	Fresh water.
Land.	

* Lyell's "Elements of Geology," p. 390.

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Marine.	Brackish.
Fresh water.	Fresh water.
Marine.	Brackish.
Brackish.	Fresh water.
Marine.	Marine.

In these beds not only do we find the remains of fresh water, brackish water, marine or land organisms as the case may be, but the time occupied by their deposition has sufficed for some species to die out and others to be introduced.

Lyell points out that each "dirt bed" in the series quoted "may no doubt be the memorials of many thousand years or centuries, because we find that two or three feet of vegetable soil is the only monument which many a tropical forest has left of its existence ever since the ground on which it stands was first covered with its shade."

Some solid rocks, attaining a thickness of several hundred feet, contain many millions of millions of minute shells. It has been calculated that in a cubic inch of a certain rock in the Basin of Paris there are 58,000 shells of foraminifera, or 3,000,000,000 in a cubic yard. Of this rock, which may be said to be almost entirely composed of the remains of living organisms, many towns and villages, including the city of Paris itself, are entirely built.

The time required for so many minute shells to have accumulated at the bottom of the sea, until they became a mass capable of being ultimately converted into a thick bed of solid rock, must have been enormous.

Turning to the Book of Genesis, and contrasting the

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account there given of the formation of "dry land" with the facts of nature as they have now been briefly sketched, we find it as deficient in its description of the broad, general facts, as it is erroneous.

The *deficiencies* of the narrative are patent, and extend far beyond the simple omission of details.

(1) It gives no hint that our rocks were formed by many diverse agencies operating through long periods of time.

(2) It says nothing whatever of the vast series of new rocks which have been formed, destroyed, and re-formed, since the period when the crust of the earth was first solidified, and which have constituted fresh surfaces of dry land in numerous successive epochs.

(3) It altogether ignores the fact that the boundaries of continents and seas have been altered over and over again during the earth's history—so that the dry land of to-day is not the same dry land as that which existed in many past periods.

The *errors* of the narrative are so far-reaching and fundamental as entirely to destroy its scientific value.

(1) The author of this portion of Genesis represents the dry land as a substance formed beneath the waters, which he thinks at first entirely covered it—so that when the waters were removed "the dry land" appeared.

He evidently knew nothing of water as a land-forming agent. Very many of the rocks now in existence have actually been formed by the action of water upon more ancient land-surfaces which have now disappeared. The waters have worn down and washed away the strata of the "dry land" of early epochs for the production of a considerable part of the land-surface on which we dwell.

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Much of our dry land, although it was at one time beneath the sea, has derived the material of which it is composed from other dry land which previously existed.

Some part of our land has been built up from the remains of primeval forests; another part from lavas which were poured forth from land as well as from submarine volcanoes.

In the district of the Auvergne, in the centre of France, are a large number of hills and mountains, which form a large part of its "dry land," and were once active volcanoes. One of these is 1,700 feet above the level of the plain from which it rises, and many of the others are several hundred feet in height. It is not only certain that these hills and mountains consist of material thrown out of volcanoes, but that they have never been beneath "the waters" at all. One clear proof of this is that some of them are entirely built up of loose cinders and ashes, burnt like those fresh from a furnace, and at the same time have their old craters perfectly preserved. Had they ever been under "the waters" these loose ashes and cinders would have been spread about by the currents; and the craters would either have been filled up or washed away. As they stand, the traveller can descend into craters 300 feet deep, which are in the precise condition in which they were when the volcano ceased to be active; and can even mark the point to which the lava rose within them, and the directions in which their streams of lava flowed.

It is an error therefore to suppose that all our existing dry land was created beneath a universally diffused covering of water.

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(2) The dry land is described as appearing all at once, in obedience to a single word of command.

It has already been shown, however, that continuous creative processes have been at work during many ages. Our rocks belong to different ages, and can be arranged in the order of their succession, and parts of our dry land were created millions of years before other parts.

(3) It is stated in Genesis that the dry land made its appearance in a single "day."

Not only is it certain, from the facts I have adduced, that millions of years had been spent upon the formation of dry land—but it is equally certain that our mountains and plains have been raised into their present position above the level of the sea, at various and often widely separated epochs.

There is evidence also that the elevation of at least a considerable part of the present surface of our land was very gradually effected.

Around the coast of Scotland old sea-beaches can be traced at different levels; one of these raised beaches is about 20 feet above the sea-level, another is 40 feet, and between the 20 feet and the 40 feet level other beaches occur. It is thus distinctly proved that the last upheaval of Scotland took place slowly; the sea at several points having had time to round pebbles in its rolling waters and deposit them in masses upon its shores.

The writer of the first chapter of Genesis is supposed by some commentators to have meant an "age" when he wrote of a "day." But even if this were the case—which is very doubtful—the facts are not met, because dry land was not formed in any one age alone

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There was dry land when the trees flourished whose trunks are found in our coal fields; there was dry land when long afterwards the leaves found imbedded in volcanic ash in the island of Mull hung upon the branches of trees, and were green in the sunshine; there was dry land when at a still more recent, but far from modern, date our arctic regions were covered by a luxuriant vegetation.

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CHAPTER VII.

THE LIFE-HISTORY OF PLANTS AND ANIMALS.

THE life-history of the plants and animals that have existed and now exist in the world, like the history of its rock masses and continental areas, has been the result of a series of continuous and connected processes.

I.

THE plants and animals now upon earth are not by any means the whole—probably not a fourth part of the whole number of those that have been created.

Every successive period during which rocks were formed has been distinguished by its own peculiar vegetation and its own special forms of animal life, both in the air and water, and upon the land. There have been at least twelve periods during which by far the greater number of species were distinct from each other.

Ever since the world became habitable new forms of life have been constantly appearing and old forms have been disappearing.

All the plants and animals which we find living at the present day have been immediately preceded by plants and animals which were of other genera and species, although they belonged to the same great divisions of

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the vegetable and animal kingdoms as those with which we are acquainted.

The genera and species most abundant in the epoch immediately before our own were in turn preceded by other genera and species having more or less resemblance to them, but yet distinctly differing from them. And so we find it to have been in every successive age as we trace back the life-history of the globe, until the most ancient organisms are reached.

An examination of a collection of fossils, such as may be found in any museum, in *their order*, will show better than any brief verbal description can, even to the most untutored eye, the wonderful *succession* in which forms of life have been introduced into the world from age to age, while, at *the same time*, rivers and seas have been depositing the material in which their remains have been ultimately imbedded.

Trilobites, a species of crustaceans (the class of animals embracing crabs, lobsters, and shrimps), for example, will be seen in abundance in the more ancient rocks, but it will be noted that they gradually diminish in number and variety, until, after the carboniferous epoch, they are found no more: after the *carboniferous** epoch gigantic "fish-lizards" (Icthyosauria), "winged-lizards" (Pterosauria), and other peculiar reptiles make their appearance, and continue until the *cretaceous* epoch, when they pass away; and long after the cretaceous epoch the great order of elephants enters the world.

* *Carboniferous, cretaceous;* these terms denote great epochs in the history of the earth. Their precise place in reference to other epochs will be seen in the table given p. 96.

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II.

THE more ancient any forms of life are, the more they differ from those now upon the earth; and the less closely are they related to each other. As our own age is approached, the plants and animals become more and more like those of the present day—as our own age is receded from they depart more and more widely from known types, until in the most ancient beds the extreme point of unlikeness is reached.

To understand the following passage from Dr. Nicholson's "Ancient Life-History of the Earth," it must be remembered that the formation called "Silurian" is older than that which bears the name of "Devonian;" and the "Devonian" older than the "Carboniferous;" the three formations indeed succeed each other. The terms Palæozoic, Mesozoic, and Tertiary have already been explained.

"The old types of life differ in many respects from those now upon the earth; and the further back we pass in time the more marked does this divergence become. Thus, if we were to compare the animals which lived in the Silurian seas with those inhabiting our present oceans, we should in most instances find differences as great as almost to place us in another world.

"This divergence is the most marked in the Palæozoic forms of life, less so in those of the Mesozoic period, and less still in the Tertiary period.

"Each successive formation has therefore presented us with animals becoming gradually more and more like those now in existence; and though there is an im-

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mense and striking difference between the Silurian animals and those of to-day, this difference is greatly reduced if we compare the Silurian fauna with the Devonian; that again with the Carboniferous; and so on until we reach the present."*

It must be added, that plants or animals which have once passed away never come back again.

When any genus or species of any living organism has died out during any epoch it is never re-created during any subsequent epoch. The relative ages of rocks may therefore be determined by the fossils they contain.

III.

THE plants and animals that now exist were *not* all created at precisely the same time.

Among the upper beds of the earth's crust—the Pleiocene strata—is a group called the "Coralline Crag." About two thirds of the mollusca which inhabited the sea at that period now live in British waters—that is, about two thirds of our mollusca are *older* than the remaining one third.

In the "Forest Bed," of the same series, 39 species of mammalia have been found, of which 17 are living and 22 are extinct. In the immediately succeeding deposits (Post-Pleiocene) 49 species are found, of which 41 are living, and 8 are extinct. It is evident that the difference between 41 and 17 (24) represents a number of living species of mammalia which came into the world *after* a number of other species now living had been created.

* p. 59.

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The mammalia now inhabiting the earth with man, that is, were formed at different periods; of insects and birds and every other creature the same thing is true—each species has had its own date of appearance upon earth.

Neither was the ground planted with all the trees and flowers we find upon it, in any single day, season, or year; but some species began to show themselves many ages before others. When the extinct elephant, for example, first roamed through the forest, Scotch firs were growing, but not roses. The Scotch fir, like several other familiar trees, flourished long before many of our common flowers blossomed.

IV.

THERE is a *general* order of succession from lower to higher types of life both in the vegetable and animal kingdoms.

What is meant by succession from "lower to higher types of life" will be understood by reference to the great divisions of the animal kingdom. These divisions are determined by the structure of animals. Animals with a backbone—an internal jointed skeleton—(vertebrate) are more complicated in structure—broadly speaking, *have more organs* specially set apart for definite purposes—than animals without a backbone (invertebrate). In this sense a dog is of a higher type than an oyster; a bird than a worm; an elephant than a grasshopper. Animals are, therefore, broadly divided into two great divisions, invertebrate and vertebrate. The "sub-kingdoms" of animals grouped in the invertebrate division represent, in the same way, lower and

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higher types. Among the invertebrata, the lowest class, protozoa (from two Greek words, *protos* first; *zoon*, an animal), such as foraminifera, sponges, &c., have their bodies composed of a mere jelly—have no nervous system; no digestive apparatus; no limbs. Animals like the star-fish have a digestive canal and a distinct nervous system, and are higher than sponges; animals like crabs, spiders, and insects, have jointed limbs, and a more elaborate nervous system, &c., and are "higher" than star-fish; animals such as shell-fish and snails (mollusca) have some more complex organs, and are generally placed at the head of the invertebrate kingdom.

Vertebrate animals also belong to higher or lower types; fish are less highly organised than amphibious animals—frogs, toads, &c.; amphibious animals are less highly organised than reptiles, tortoises, snakes, lizards, crocodiles, &c. Reptiles are less highly organized than birds; birds are less highly organized than mammalia (kangaroos, whales, horses, lions, rats, beavers, apes, man, &c.). The earliest animals that came into the world belong to the invertebrates. Invertebrates existed before vertebrates; fish before amphibious animals; amphibious animals before reptiles; reptiles before birds; birds before mammalia.

Doubtless mammalia, birds, reptiles, and fish, will be discovered in more ancient beds than any in which they are now known to occur, but the *general principle* that the sequence of the great groups of plants and animals in the life-history of the world is directly connected with the simplicity or complexity of their organization is as firmly established as the law of gravitation.

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The more simply organized groups of plants and animals are the most ancient, in order of appearance; the more highly organized groups are the most recent.

I have advisedly used the word "groups." Certain genera belonging to comparatively simple forms of life may be found to exhibit a more elaborate complexity of organization than they possess at the present day; but this only means that some low types attained their own perfection in ancient times; and does not affect the law I have stated with respect to the succession of the great *divisions* of the vegetable and animal kingdoms.

The Life-History of the world has been divided into Seven Ages.*

(1) Archæan Time.†

Belonging to this age a series of rocks containing rolled stones, and clearly deposited by water, are found, showing that there was a still older land surface than any now forming a visible part of the earth. Sir Wm. Dawson believes that he has found in these lowest known rocks the earliest form of life. It is a foraminifer, and has been named the Dawn-animal (Eozoon). It is described as consisting of chambers built over each other in tiers, and bounded by walls perforated with tubes. It is questioned, however, by many whether mineral has not been mistaken for animal structure; and no final decision has yet been reached. The late Dr. Carpenter threw the weight of his eminent authority

* "Manual of Geology," by Phillips. Part II. Edited by Etheridge, p. 4.

† Archæan—from a Greek word signifying ancient, or of the beginning.

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on the side of those who contend that "Eozoon" has a true organic structure. The Archæan rocks yield no other remains which can, even in any questionable way, be said to prove the existence of organic life—although their beds of graphite* and limestone may have been produced by plants and animals.

(2) Age of Invertebrates.

This is the age of the rocks called "Cambrian" and "Silurian." At its beginning there was an invertebrate water population; later on there was an invertebrate air and land population; and some fish (the lowest among the vertebrates) appeared. Invertebrates, however, so largely predominated as to be characteristic of this oldest period next to the Archæan.

(3) Age of Fishes.

In the succeeding "Devonian or Old Red Sandstone" period fish were abundantly intermixed with the invertebrates.

(4) Age of Amphibians.

The beds belonging to the "carboniferous" formation (the next in order of succession) show an enormous development of certain kinds of plants; but, confining our attention to animals, in this age *Amphibians*—the class of reptiles between fish and the most highly organised true reptiles—appear.

(5) Age of Reptiles.

From the end of the "Carboniferous" to the end of the "Cretaceous" period reptiles attain an enormous development. A vertebrate air-population (birds and winged lizards) is also added to the globe.

* Graphite—almost pure carbon—frequently formed from the remains of plants.

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(6) Age of Mammals.

As the old forms of reptiles pass away and are replaced by others in nearer alliance to existing species all the divisions and sub-divisions of mammalia are introduced.

The earlier mammalia differ widely from our present types; but as the age of man is approached they become more and more like those with which we are familiar.

(7) The age of man.

Whether any new species of plants or animals have been created since the formation of man is uncertain; but it is certain that man has lived upon earth in company with many creatures now extinct.

The following table sums up the facts, and shows at a glance what is at present known respecting the first appearance of each great class of animals :—

Eozoic Epoch.	Archæan Period.	Marine foraminifera? (Eozoon).
Palæozoic or Primary Epoch.	Cambrian Period.	Invertebrate marine animals (such as zoophytes, mollusca, crustaceans, &c.) abundant. Sea-weed; corals. No fish, reptiles, birds, or mammalia.
	Silurian Period.	Invertebrate air and land animals (flying insects, scorpions). Marine vertebrate animals (fish) in upper beds; not abundant. No reptiles, birds, or mammalia.

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Paleozoic or Primary Epoch.	Devonian or Old Red Sandstone Period.	Marine vertebrate animals (fish) abundant. No reptiles, birds, or mammalia. Ferns and conifers.
	Carboniferous Period	Vertebrate animals adapted to live in land and water (amphibia). No reptiles of the higher types, birds or mammalia. Enormous quantities of low plant life; ferns, conifers, but no flowering plants.
	Permian Period.	
Mesozoic or Secondary Epoch.	Triassic Period.	Land vertebrate animals (reptiles) abundant. No birds. First mammalia of low type; pouched animals allied to kangaroos.
	Jurassic Period.	First true bird, allied to lizard; flying lizard; pouched mammalia.
	Cretaceous Period.	Toothed birds; appearance of first true flowering plants.
Cainozoic or Tertiary Epoch.	Eocene Period.	Mammalia of comparatively low types; tapirs, &c.
	Miocene Period.	Mammalia increasing in abundance and degree of organization.
	Pleiocene Period.	Mammalia abundant.
	Post-Pleiocene or Pleistocene Period.	Mammalia of the highest type; man.

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It is not necessary for the purpose of rendering the argument of this book intelligible to enter into detailed explanations of the terms used in this table. Such explanations will be found in any geological manual. All that the reader needs to remember is that the history of the earth's crust can be divided into great epochs—that these epochs succeeded each other in a definite order—that each epoch is marked by its own groups of plants and animals, and that the nearer the epoch of man is approached the higher in organization those plants and animals become, and the more like to those now existing. What the technical names given to those epochs are does not affect the argument.

As I have previously stated, mammalia, birds, reptiles, and fish will very probably be found in beds more ancient than those in which they have as yet been met with; but the general succession of each great division of the Animal Kingdom has clearly taken place in the order of ascent from lower to higher forms of life.

Marine invertebrate animals are found in the most ancient beds, without any fish, reptiles, birds, or mammalia among them. Fish, the lowest of the vertebrates, are in the first instance added; then the lower reptiles; then highly organized reptiles and birds; then the lower or pouched mammalia; and it is only in the last epoch that the higher mammalia enter the world, and man crowns the long, vast, and complicated series.

The following conclusion has been drawn from an examination of the various groups of animals which have inhabited the seas within the area now known as Europe :—*

* "Manual of Geology," by Phillips, Part II., Ed. by Etheridge, p. 25.

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"That the earliest *faunas** which reached the European continents indicated a lower type of organic life than those which succeeded them; and that each successive *fauna* seemed to indicate a higher state of progression, the lowest invertebrates appearing first, and the higher groups not until several preceding *faunas* had appeared."

V.

THE numerous varieties of plants and animals which have flourished during many epochs were not created separately and altogether independently of each other.

One or two established facts may make this statement intelligible, although the subject is so vast and intricate that it scarcely admits of a brief discussion.

1st. Many species, which are classified by naturalists as distinct, are so closely related that it cannot be doubted that they are descended from a common ancestry.

Darwin made a study of pigeons. The diversity of their breeds is astonishing; and at least a score differ as widely as well defined species of wild birds.†

"Compare the English carrier and the short-faced tumbler, and see the wonderful difference in their beaks, entailing corresponding differences in their skulls. . . The short-faced tumbler has a beak in outline almost like that of a finch; and the common tumbler has the singular inherited habit of flying at a great height in a compact flock and tumbling in the air head over heels.

* *Fauna.*—The whole of the animals inhabiting a certain country or region.

† Darwin's "Origin of Species," p. 15.

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The runt is a bird of great size, with long, massive beak and large feet; some of the sub-breeds of runts have very long necks, others very long wings and tails, others singularly short tails. The barb is allied to the carrier, but instead of a long beak has a very short and broad one.

"The pouter has a much elongated body, wings and legs; and its enormously developed crop, which it glories in inflating, may well excite astonishment and even laughter. . . The Jacobin has the feathers so much reversed along the back of the neck that they form a hood; and it has, proportionally to its size, elongated wing and tail feathers. The trumpeter and laugher, as their names express, utter a very different coo from the other breeds. The fantail has thirty or even forty tail feathers, instead of twelve or fourteen—the normal number in all the great pigeon family; these feathers are kept expanded, and are carried so erect that in good birds the head and tail touch. . . In the skeletons of the several breeds the development of the bones of the face in length and breadth and curvature differ enormously. . . The shape and size of the eggs vary. The manner of flight, and in some breeds the voice and disposition, differ remarkably."

Great as are these differences between the breeds of pigeons they are all descended from the rock-pigeon.

What has been done by man in the breeding of pigeons is found to have occurred in nature, upon a large scale.

Numerous species of many creatures which appear entirely distinct can be traced back, link by link, through many small divergences, until some earlier forms

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are reached, from which they have as clearly descended as the tumbler, the pouter, the Jacobin, the fantail, the trumpeter, the laugher, &c., from the rock-pigeon.

The history of the horse affords a notable example.

In the Eocene period hoofed quadrupeds lived which possessed some few of the characteristics of true horses.

As the various species of these hoofed quadrupeds succeeded each other some among them approximated more and more closely to the modern horse, which at last is found fully developed both in Europe and America immediately before the time at which the history of man (so far as it is at present known) begins.

2nd. Many animals have the *remains* of organs which are of no use whatever to them in their present condition—and which must be relics inherited from their remote ancestors, who are thus proved to have differed very widely from their descendants.

Beetles exist, possessed of either full wings or rudiments of wings, which are perfectly useless to them—lying as they do under wing-covers firmly soldered together. The ancestors of these creeping beetles must have been able to fly.

The boa-constrictor has very imperfectly developed (rudimentary) hind legs. Some ancestor of the boa-constrictor must have walked.

Teeth can be detected in the embryo* of whales. Some ancestor of the whale must have used teeth.

3rd. In great districts marked by the presence of peculiar animals the animals now existing are closely allied to those that preceded them.

* *Embryo.*—The young in incomplete condition.

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In Australia the Kangaroo is allied to extinct forms of animals of the same type, whose remains are found in the uppermost beds. In South America all the peculiar living mammalia which characterize that continent are represented by species which were like, and yet unlike, them, and which dwelt in the same regions immediately before they appeared. The conclusion seems clear that the animals now living in Australia and South America are directly descended from those that entered into those countries before them, although they are in many respects different from them.

The laws by the action of which the various species of plants and animals have been produced are subjects of debate—but it is beyond debate that *they have been produced by the action of definite laws.*

The following extract from Sir John Lubbock's address to the British Association for the Advancement of Science at York (1881) will show the direction along which modern discoveries are guiding the thoughts of students.

"Fifty years ago it was the general opinion that animals and plants came into existence just as we now see them. We took pleasure in their beauty; their adaptation to their habits and modes of life in many cases could not be overlooked or misunderstood. Nevertheless, the book of Nature was like some richly illuminated missal written in an unknown tongue; the graceful forms of the letters, the beauty of the colouring, excited our wonder and admiration; but of the true meaning little was known to us; indeed, we scarcely realized that there was any meaning to decipher. New glimpses of the truth are gradually revealing themselves; we perceive

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that there is a reason—and in many cases we know what that reason is—for every difference in form, in size, and in colour; for every bone and every feather, almost for every hair. . . . . With this great change the name of our illustrious countryman, Darwin, is intimately associated; and the year 1859 will always be memorable in science, as having produced his great work on 'The Origin of Species.' . . . . The theory is based on four axioms:—

"1. That no two plants or animals in nature are identical in all respects.

"2. That the offspring tend to inherit the peculiarities of their parents.

"3. That of those which come into existence only a small number reach maturity.

"4. That those which are on the whole best adapted to the circumstances in which they are placed are most likely to leave descendants.

"Darwin commenced his work by discussing the causes and extent of variability in animals, and the origin of domestic varieties; he showed the impossibility of distinguishing between varieties and species, and pointed out the wide differences which man has produced in some cases, as, for instance, in our domestic pigeons, all unquestionably descended from a common stock. He dwelt on the struggle for existence (which has since become a household word), and which, inevitably resulting in the survival of the fittest, tends gradually to adapt any race of animals to the conditions in which it occurs.

"While thus, however, showing the great importance of natural selection, he attributed to it no exclusive in-

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fluence, but fully admitted that other causes—the use and disuse of organs, sexual relation, &c.—had to be taken into consideration."

VI.

THERE was a picturesque simplicity in the old notion, not only that all creatures were fashioned precisely as we find them, but also that they were all originally placed in those regions in which they now dwell.

Of course no creature can live at all unless its surroundings are suitable, but it does not follow either (1) that it was created where we find it; or (2) that it might not flourish in some other country if it could get there.

The changes of level in the earth's crust, and the accompanying variations of climate of which I have frequently spoken, have caused perpetual migrations of all forms of life. By the conversion of continents into islands, and of islands into portions of continents; of lakes into estuaries, and estuaries into lakes; of fresh-water rivers into arms of the sea, and arms of the sea into fresh-water rivers; of marshes into well-drained plains, and well-drained plains into marshes; attended by shiftings in the directions of winds, and currents, and alterations of temperature, all species of plants and animals at all periods have been flung into a state of perpetual movement within the range of certain broad divisions.

The present distribution of vegetable and animal life, like the formation of rocks and the origin of species, was not effected in any one "day" or "age," but has also been the result of a series of continuous and connected processes.

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A typical case may be quoted from Wallace's "Geographical Distribution of Animals."

The Island of Madagascar has a fauna in the main African, but (1) it has three peculiar families, and (2) all the higher African forms—such as apes, lions, leopards, zebras, giraffes, elephants, &c.—are wanting.

What is the explanation? Madagascar must have been an island before these last named animals entered Africa at all, or they would have wandered over it; and being an island its own circumstances have caused the development of some animals peculiar to itself.

During the glacial epoch—an epoch subsequent to the "Tertiary Period"—among other Arctic mollusca, one called Panopœa Norvegica was abundant in British waters. It is now abundant in the Arctic seas, and is only found living in one place—the Dogger Bank—off the British coast.

Why is this? This mollusc cannot endure heat; as the climate became warm it travelled northward, but since a cold current passes over the Dogger Bank it has lingered in that locality. Clearly, therefore, its present distribution has been the result of influences which have been at work since its first creation.

The author of Genesis imagines, 1st, that on the third "day" God created the whole of the species and genera of the vegetable kingdom (Gen. i. 11, 12, 13):—

And God said, Let the earth put forth grass, herb yielding seed and fruit tree bearing fruit after its kind, wherein is the seed thereof, upon the earth; and it was so.

And the earth brought forth grass, herb yielding seed after its kind, and fruit trees bearing fruit wherein is the

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seed thereof, after its kind; and God saw that it was good. And there was evening and there was morning, a third day.

2nd, That on the fifth "day" God created all the birds and the fish (Gen. i. 20, 21, 22):—

And God said, Let the waters bring forth abundantly the moving creature that hath life, and let fowl fly above the earth in the open firmament of heaven.

And God created the great sea-monsters, and every living creature that moveth, which the waters brought forth abundantly, after their kinds, and every winged fowl after its kind; and God saw that it was good. And God blessed them, saying, Be fruitful and multiply and fill the waters in the seas, and let fowl multiply in the earth. And there was evening and there was morning, a fifth day.

And 3rd, That on the sixth day God created all the beasts on the earth, without exception (Gen. i. 24, 25):—

And God said, Let the earth bring forth the living creature after its kind, cattle and creeping thing, and beast of the earth after its kind: and it was so. And God made the beast of the earth after its kind, and the cattle after their kind, and everything that creepeth upon the ground after its kind; and God saw that it was good.

It was very natural that when nothing was known that science has revealed, this extremely simple conception of the order of creation should have entered the mind of man. It is no more wonderful than are the speculations of curious and inquiring children, that men in those early ages should have thought that, in the first place, God made plants to grow; that, in the next place, He filled the sea with fish and the air with birds; and

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that when all this was done he made the beasts of the field.

No theory of special inspiration is needed to explain how an ancient author could have written such a narrative—it only contains ideas that would be suggested to a reverent mind by the first glance at nature. Criticism would be needless were it not that belief in its accuracy is often demanded as an essential requirement of religion.

It is unnecessary to recapitulate the established facts which have been already dwelt upon; bearing them in mind, it will not be difficult for the reader to understand the chief points in which this account of the life-history of the world is at once as imperfect and erroneous as the account of the formation of dry land.

The narrative is so *deficient* as to be practically misleading.

(1) It does not suggest, directly or indirectly, that any plants or animals ever existed except those which are now upon earth.

The author of the second account of the creation even states that "every" beast and bird made by God was brought to Adam to receive a name.

Gen. ii. 19, 20. *And out of the ground the Lord God formed every beast of the field and every fowl of the air; and brought them unto the man to see what he would call them; and whatsoever the man called any living creature that was the name thereof.*

Thousands upon thousands of species and genera, however, in addition to those known to man, have been created in successive ages.

(2) The narrative does not raise in the reader's mind

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the slightest suspicion that the plants and animals which first appeared differed widely from those which now exist upon earth—but this is known to have been the case.

(3) Neither does it contain a hint of the facts that the lowest forms of plants and animals were created first—that as they became extinct they were replaced by more highly organized types—that these more highly organized types passed away in turn and were succeeded by types still higher in the rank of being, until the present populations of earth and air and sea were fully developed.

It is frequently pleaded that these things are omitted because the author of the first chapter of Genesis did not intend to teach science; and I admit that his chief purpose was distinctly and nobly a religious one. At the same time, as a matter of fact he *does attempt* to explain the order in which plants and animals were made; and when acceptance of his statements on this special subject is required as a religious duty, I reply that the omissions are so vital as to show that he was not acquainted with the facts.

The actual *errors* contained in the narrative are as striking as the omissions.

(1) The writer supposes that *all* plants were made at one distinct time; all fish and birds at another; and all the beasts of the earth at another.

It has been found that new species of every kind of "living thing"—whether dwelling in the water or on the earth or in the air, have been created at many different epochs, divided from each other by countless ages.

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Even if the plants and animals now living alone be considered, they were introduced at various times, and some species have a more ancient history than others.

(2) This distinct time is limited to "a day," having a morning and an evening.

Ages, however, have been spent in the creation of the numberless species of organisms which have succeeded each other and been distributed over the earth from epoch to epoch. They are found imbedded in strata which were deposited by the slow action of water, and have been piled one over the other to the height of hundreds of feet.

Commentators say (as has been previously mentioned) that by "day" an "age" is meant. Even this supposition does not make the narrative correct—for the reason given in the preceding paragraph. New plants, new fish, new reptiles, new birds, new mammalia, often came into existence during one and the same age.

(3) The order in which living things were created is wrongly described.

All plants were not created before all the living things that move within the waters. Many kinds of fish and other marine animals dwelt in the sea before the species of trees found in our coal fields flourished; and long, long before the growth of any single one of the trees of our own forests.

All the living things that move within the waters were not created before all the beasts of the earth.

Whales and porpoises belong to the highest order of animals, the mammalia.

The mammalia were the last great class of animals

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introduced into the world—of this the fossils in the rocks give the most distinct evidence. Reptiles were created long before mammalia.

The land had its beasts, in the shape of reptiles therefore, before the sea had its mammalia in the shape of whales and porpoises.

(4) The plants and animals existing in his own day are those which are described by the writer of Genesis as the very plants and animals created by God as soon as he had bade the dry land appear, and called together the waters into their place.

This is evident from the whole tenor of the narrative in the first chapter, as well as from the statement made in Genesis ii., that as soon as "every beast of the field and every fowl of the air" were formed, they were brought unto the man "to see what he would call them."

The living things inhabiting the world with man, however, were *not* the first creations of God.

Almost all, if not the whole, of the *first-formed* species, belonging to every division of the vegetable and animal kingdoms, have perished, and their places have been filled by others.

The plants and animals around us are for the most part the very last, and not the first, of the Creator's works.

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CHAPTER VIII.

THE CREATION OF MAN.

WHEN did man make his first appearance upon earth?

By virtue of his noble mental and moral attributes, as well as the high development of his physical organisation, man stands at the head of the vast series of living creatures. It does not follow that he was absolutely the last of beings in the order of creation.

The development of species has gone on along many separate lines; and the coming in of the highest form of life would not necessarily cause the production of lower forms to cease.

It will be no matter of astonishment, therefore, if it should be discovered that man is more ancient than many existing species of animals. This, however, is at present a matter of speculation.

The following three propositions have been fully proved.*

1st. *Man lived with many animals now extinct, and also dwelt with many living animals in regions in which they are not now found.*

In many caves, both in Great Britain and on the continent of Europe, either the bones of man or articles of undoubtedly human workmanship are associated with

* *See* the words of Lyell, Lubbock, Boyd Dawkins, J. Geikie.

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the bones of the lion, the hyena, the hippopotamus, the rhinoceros, the elephant, the mammoth, the woolly rhinoceros, the musk-sheep, some of these animals being of extinct species.

In a cave near Wells, on the south side of the Mendip Hills—Wookey Hole—bone arrow-heads have been found, together with ashes and burnt bones, showing that men had cooked their food within it. One of these bones belonged to a rhinoceros, and was cooked when it was fresh. Boyd Dawkins pronounces the evidence of this to be conclusive. "One fragment of bone in particular, belonging to the rhinoceros, had been calcined, and its carbonised condition bore unmistakable testimony that it had been burnt while the animal's juices were present."*

In Kent's Cavern (Devonshire) the following succession of beds has been dug through, by which the history of man in Great Britain has been wonderfully illustrated.†

1. Black Mould, with Roman pottery of recent origin.

2. Stalagmite (*i.e.*, a crust-like deposition of lime, formed by the evaporation of the water dripping from a roof of limestone), with bones and teeth of bear, elephant, hyena, rhinoceros, horse, fox, and man.

3. Black Band, chiefly composed of charred wood, with an oval and barbed harpoon of human workmanship, and remains of rhinoceros, hyena, &c.

4. Red cave earth, full of human relics and the remains of lion, bear, mammoth, rhinoceros, hyena,

* "Cave Hunting," p. 2.

† *See* "Reports to British Association," by Mr. Pengelly.

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reindeer, beaver, &c., &c., both of extinct and living species.

5. A second bed of stalagmite, from 3 to 12 ft. thick, with numerous bones of bear.

6. Stones and pebbles imbedded in sand, with human implements made of flint.

The remains of man are so closely associated in this cave with those of the animals (some of which are extinct, and others have gone to other regions) that there is no manner of doubt that he at one time dwelt with them in Britain.

That man lived with the mammoth and the reindeer in France is proved in a most remarkable way—the horn of a reindeer having been found with the picture of a mammoth roughly engraved upon it.

2nd. *Considerable fluctuations of climate have taken place in the world since the appearance of man.*

Prof. J. Geikie arranges in three groups the animals which lived with man in our continent.* (1.) The Southern groups, comprising those species that are now found living in latitudes south of the Black Sea and the Mediterranean; *e.g.*, hippopotamus, African elephant, hyena, &c. (2.) Northern and Alpine groups, comprising those species which we now meet with only in northern latitudes, or in mountain ranges where similar climatic conditions obtain, *e.g.*, reindeer, Arctic fox, Alpine hare, &c. (3.) Temperate groups, comprising species which are characteristic of temperate latitudes, *e.g.*, bison, bear, &c.

It is clear that southern, northern, and temperate

* "Prehistoric Europe," p. 31.

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groups of animals could not have all lived with man at the same time, in the same regions.

They all, however, *did* dwell with man in Great Britain and on the European continent. Very great—although probably very gradual—changes of climate must, therefore, have taken place since man's creation.

3rd. *Since the beginning of the human period the boundaries of sea and land, as well as the courses of rivers, have been considerably altered.*

The Baltic, for example, was a more open sea than it now is, when man first lived upon its shores. Lyell gives a curious proof of this.*

"Upon the shores of the Baltic are extensive refuse-heaps, accumulated by the rude hunters and fishers who once lived there. Scattered through them are fragments of pottery, and instruments of stone, horn, wood, and bone; and also shells of the animals they pick up on the sands and eat. These shells have a tale to tell.

"These consist of living species; but in the first place, the common eatable oyster is among them, attaining its full size, whereas the same *ostrea edulis*† cannot live at present in the brackish waters of the Baltic, except near its entrance, where, whenever a north-westerly gale prevails, a current setting in from the ocean pours in a great body of salt water. Yet it seems that during the whole time of the accumulation of the 'shell mounds' the oyster flourished in places from which it is now excluded. In like manner the cockle, mussel, and periwinkle, which are met with in great numbers in the 'refuse heaps,' are of the ordinary

* "Antiquity of Man," p. 13.

† Ostrea edulis—the common eatable oyster.

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dimensions which they acquire in the ocean, whereas the same species now living in the adjoining parts of the Baltic only attain a third of their natural size, being stunted in their growth by the quantity of fresh water poured by rivers into that inland sea. Hence we may confidently infer that in the days of the aboriginal hunters and fishers the ocean had freer access than now to the Baltic, communicating probably through the peninsula of Jutland—Jutland having been at no remote period an archipelago."

Almost all the British bone caves, in which the remains of man are mingled with those of extinct animals, show that the channels of our streams must have altered during the human epoch. For water to have flowed into a cave it must of course have stood at its level. When a cave contains water-worn shingle, but is at present high and dry, far away from the reach of any stream, it is clear that an *old stream* must once have been at work, at the level of the cave, or no shingle at all could have been washed into it.

A cave, *e.g.* on the side of a hill near Brixham, Torbay, in which the remains of man and the mammoth occur, contains *rolled* stones and pebbles, and shows other indications of having been visited by flowing water. The streams of the district, however, do not now reach the cave. The inference is obvious; the valley of Brixham must have been at one time less deep than at present to have enabled the waters of its streams to have entered the cave; and it has been calculated that this increase in the depth of the valley since the time of man cannot have been less than from 70 to 80 ft.

Excavations in the plain on which Glasgow is built

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have brought to light many canoes—some under the very streets of the city itself.

One of these canoes was 25 ft. beneath the surface; and their average depth was about 19 ft. They were chiefly imbedded in finely laminated sand, and were dug up at different points over an area extending to a distance of more than 100 yards back from the edge of the Clyde, as it flowed before its course was banked in by modern engineers. Some were found at high levels, and could not possibly have been drifted to or sunk in their resting-places by mere floods of the Clyde flowing seaward in its present channel.

They differ in workmanship, but some are of a very primitive character.

They were formed of single oak-trees—two had been hollowed out partly by fire; others were scooped out. A canoe which has been preserved in the museum of the Andersonian University, Glasgow, measures 11 ft. 10 in. in length, breadth at the stem 2 ft.; at the centre 1 ft. 10 in., and at the bow 1 ft. 8 in.

This canoe has been very rudely constructed. The roughness of the floor indicates the blunt and imperfect tools employed. She has no cut-water; no perforations; no indentations; the tree roots have merely been rounded in a very primitive manner at the one end, while the opposite extremity resembles the snout of a cobble. There is no keel, but simply the original rim of the tree.*

A stone hatchet was found in one canoe, showing the kind of tools in use.

* *Vide* "Researches in Newer Pliocene Geology," by James Smith, p. 166.

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Some canoes are more clearly cut and more elaborately constructed than others, and it is possible that in their making iron implements were used.

Water must unquestionably have flowed in ancient times over the places at which these canoes have been discovered. They were covered by many feet of sediment, clearly deposited by water, and it is absolutely impossible that they could have been dragged over land and artificially buried. One canoe was lying keel uppermost, with her prow pointing straight up the river, as though she had been capsized in a storm.

The point of interest and importance established by these facts is that man dwelt in Scotland, in a comparatively savage state, when what is now the area of Glasgow was the bottom of a shallow estuary of the sea.

When this state of things prevailed in the neighbourhood of Glasgow the areas of land and water throughout the whole district must have had boundaries differing from those which have been fixed by the latest upheaval of Scotland. The Firth of Forth, for example, must have been connected by water with the Firth of Clyde. Positive evidence of this particular change of water-level can indeed be produced, referring it also to the human epoch.

Canoes resembling those of Glasgow have been found near Falkirk and at other places in the valley of the Forth, at depths of about 15 feet, covered by successive strata of clay, shells, moss, and gravel.

In the plain intervening between the Firth of Forth and the Firth of Clyde several skeletons of whales have

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also been dug up from beneath beds of peat and clay, and in two instances rude harpoons formed of deers' horns lay alongside the skeletons.

Human remains are found *beneath* deposits accumulated by the action of ice, under circumstances which appear to many high authorities to prove that man lived in Great Britain before it was covered with ice during the comparatively recent Post-Tertiary epoch. The precise date of man's appearance is not, however, settled; but it is certain, from the association of his bones and weapons with the bones of arctic animals, that he lived in our own country when its climate was much colder than it is at present. During the Glacial epoch—in some part of which man was an inhabitant of Great Britain—the following physical changes, and probably several others, took place :—

1. At its commencement the land stood at a slightly higher level. This is shown by the existence of old river beds, which could not otherwise have had any flow of water through them.

2. A subsidence took place. In Scotland arctic shells have been found 500 feet above the sea level; and in Wales there are sands and gravels containing a proportion of arctic shells at a height of 1,370 feet.

3. A re-elevation came, and the surface of the land was raised to a point higher than its present level. Numbers of great trees, with their roots in a natural position, are found in places now washed by the tide—as, for example, near Barmouth, and the land must have been higher to have permitted their growth.

4. The land finally subsided into its present position.

5. A climate as severe as that of Greenland gradually

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became, through various fluctuations, the temperate climate of to-day.

A portion, at least, of these changes have been witnessed by man since he certainly dwelt with arctic animals in Great Britain, as well as with other animals which could only have flourished when the climate was more genial. In many other parts of the world corresponding changes have taken place subsequently to the appearance of man. When man was created the dry land was not precisely the existing dry land—the plants and animals on the earth were not all of the same species as those that now live; neither were they all distributed as they now are over continents and islands.

In many respects, therefore, the world in which we live is not the same world as that which was inhabited by our ancestors.

The Book of Genesis, it will be remembered, contains two accounts of the creation of man.

According to the second account, a man was placed upon the earth before its plants and herbs had begun to grow at all; and "every beast of the field and every fowl of the air" was subsequently formed. The order of creation given in the second chapter of Genesis is the following:—

1st. The creation of earth (without plants and herbs) and heaven.

2nd. The rising of a mist, watering the earth.

3rd. The formation of a man. } These two acts are
4th. The planting of a garden } described as
and the growth of trees. } almost simultaneous.

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5th. The formation of every beast and bird.
6th. The making of a woman out of a rib of the man.

A single fact, among many that have been dwelt upon in this chapter, will suffice to show that the period thus assigned to the formation of man is inaccurate; the remains of beasts of the field and fowls of the air, as well as of herbs, plants, and trees, are found in strata which were unquestionably deposited ages before the existence of man.

The assertion that a rib was taken from the body of the man and made into a woman is no more a subject for serious criticism than the Greenlander's belief that the first woman was formed out of a man's thumb.

According to the first account in the Book of Genesis, man and woman were created together (i. 37), after every other part of the creative work, whether connected with the sea and the dry land, or the existence of plants and animals of every description, had been finally accomplished.

We have seen, however, that this was not the case. Since the creation of man the development of animal life has gone on to, at least, a sufficient extent to cause the extinction of many species, and great changes alike in the climate and in the physical geography of our islands and continents have been effected.

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CHAPTER IX.

THE CREATION OF "THE HEAVEN AND THE EARTH" NOT YET "FINISHED."

THE heaven and the earth, according to the Book of Genesis, *were finished* at a certain definite period of time (Gen. ii. 1–3): *And the heaven and the earth were finished, and all the host of them. And on the seventh day God finished his work which he had made; and rested on the seventh day from all his work which he had made. And God blessed the seventh day and hallowed it; because that in it he rested from all his work which he had created and made.*

From the discoveries made by scientific men in every direction we learn that "the heaven and the earth" cannot in any sense whatever be said to be finished. Year by year, month by month, day by day, hour by hour, minute by minute, some entirely new arrangements are being established. The Creator is not resting, and there is not the slightest evidence that he ever has rested, like a labourer who has fulfilled his appointed task. The work of creation is going on at this moment as marvellously as when the foundations of the earth were laid, and "the morning stars sung together and all the sons of God shouted for joy."

As no great epoch is repeated in the present, so the present epoch will not be repeated in the future.

A new earth is as truly being created by forces now in

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operation as the present earth has been created by the forces acting in the days gone by.

The grounds for believing that this world is not a finished work, and that the Creator's activity has never ceased, will be understood as we observe what is happening every hour of every day, and every moment of every hour. In previous chapters I have given some details concerning the points which I now recall for the purpose of emphasizing their full meaning.

The processes by which rocks were formed are still going on.

Sands are being drifted by the wind until they are gathered together in heaps, and are being accumulated and spread out along our coasts, during the ebb and flow of tides. These masses of sand have but to be pressed together, the surface of the earth has but to subside, and then again to be uplifted, and a solid rock will be formed.

Mud and silt are being spread over our estuaries. During every storm each petty rivulet brings its tribute to their increasing mass—and the material for new rocks is thus also in process of collection. Volcanoes frequently pour forth streams of lava and showers of ash ; and the great molten floods as they cool, and the heaps of dust and earth as they harden, form a new crust for part of the earth's surface. Coral islands are being upbuilt in our oceans to-day as in long past ages. Millions of minute shells are now falling upon the bottom of the Atlantic, furnishing material for new "chalk."

Great trees fall in our forests and are carried down by rivers and are covered up by silt, in preparation for peat and possibly coal-beds of times to come.

Mechanical pressure—chemical agencies—and other forces capable of affecting the structure of the masses

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of sand, clay, limestone, vegetable and animal matter which are now being deposited—are still active.

The level of the solid land is shifting—here submergence, there upheaval, is taking place.

The forces now acting are perfectly competent to reunite Great Britain to the Continent, and Europe to Africa; to cover the Sahara with waters and substitute a chain of lakes for the now unbroken desert; or to do any corresponding marvellous and mighty piece of work.

No new agency need be introduced to reduce or increase the heights of our mountains, the depths of our lakes and seas, the volume of our rivers, the boundaries of our continents.

Frequently recurring earthquakes show that the earth is not at rest in the interior of its crust any more than upon its surface.

Organically, in no one year is the distribution of the fauna and flora of any one place precisely what it was the year preceding. I have watched the effect of the destruction of hawks in a half-cultivated district in the West Highlands. An increase in finches took place and the produce of the garden was at once affected. If this slight change in the destruction of one bird had a perceptible influence the vast influences of the changes going on throughout the world may be easily imagined. What is the result of the non-appearance for one season of a swarm of fish at a particular spot it frequented the preceding year? It means an increase of certain other creatures, which had previously been devoured. The whole population of the waters, from the place whence the swarm comes to where it wanders, is indeed affected.

Nay more, the most powerful of agents ever known

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for effecting changes in the fauna and flora, as well as to some slight extent in the physical geography of the world, has been introduced in the shape of man.*

A change in the plants of any district affects the animals by which it is frequented; a change of animals, the plants.

A large number of carnivorous animals now in the world will ultimately be as completely exterminated as wolves in England. Every year the process of their destruction is going on, wherever man comes into conflict with them. This will cause the numbers of the animals upon which they prey to increase; and the plants upon which *those* animals depend will suffer in consequence of the larger consumption of them which will ensue. It has been calculated, for example, that in Algeria each lion costs the colony £800 a year because of the number of cattle it devours; and that in Russia wolves devour on an average upwards of £2,000,000 worth of sheep annually. Were these lions and wolves destroyed sheep and oxen would multiply; did sheep and oxen multiply the grass of the pasture lands would be more closely eaten down; were the grass more closely eaten down many kinds of insects as well as flowers would diminish in number.

Jackals destroy vast numbers of fowl and other birds; were there no jackals in many districts there would be a great many more birds; were there more birds, the seeds of the plants upon which they feed would be the more completely picked up, and of course fewer plants of those particular kinds would grow.

How the destruction of one animal causes the increase

* See Dr. Marsh's "Man and Nature,"—a book to which I am indebted for some of the illustrative facts I give.

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of another may be learnt from the following instance: in the Island of Bourbon a price was set upon the head of a martin, which was supposed to be injurious. It was destroyed, and grasshoppers of the species upon which the martins fed took possession of the island, devouring everything before them.

Transplanting a plant from its habitat means "the introduction of a new geographical force."

During the wars with Napoleon Russian troops brought, in the stuffing of their saddles, seeds from the Dnieper to the Rhine; and plants of the Steppes to the environs of Paris. Turkish armies brought eastern vegetables and seeds of Oriental plants to grow upon the ramparts of Buda and Vienna. Four species of plants are now living in Denmark which were brought from Italy in the straw used for packing Thorvaldsen's works of art.

The clearing of forests has far-reaching results. It influences rainfall, soil, vegetation, and the development of insect life.

By planting sand-dunes with a species of reed a rich soil is produced, and support secured for plants and animals which could not previously obtain food. On the eastern shores of the Atlantic and the Baltic are a million of acres of sand-dunes, a small portion of which has been already fertilized. Extraordinary changes in the fauna and flora of this area will be effected by their total reclamation. Darwin gives a striking example of the changes effected in the plants and animals of a district, simply by enclosing it and introducing one single kind of tree.

"In Staffordshire, on the estate of a relation where I had ample means of investigation, there was a large and

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extremely barren heath, which had never been touched by the hand of man; but several hundred of acres of exactly the same nature had been enclosed twenty-five years previously and planted with Scotch fir. The change in the native vegetation of the planted part of the heath was most remarkable, more than is generally seen in passing from one quite different soil to another; not only the proportional numbers of the heath plants were wholly changed, but twelve species of plants (not counting grasses) flourished in the plantation which could not be found on the heath. The effect on the insects must have been still greater, for six insectivorous birds were very common in the plantations which were not to be seen on the heath; and the heath was frequented by two or three distinct insectivorous birds. Here we see how potent has been the effect of the introduction of a single tree, nothing whatever else having been done, with the exception of the land having been enclosed, so that cattle could not enter."*

A thousand other illustrations of man's power over nature could be given; and it is scarcely too much to say that if the human race lasts for another million of years the world, with all the living creatures dwelling upon it, will be made to feel its authority almost from pole to pole.

As the result of all these physical and vital change-producing causes, the earth at this passing moment is not precisely the same earth as it was five minutes ago.

By the rolling of tides; the motion of streams and rivers; the blowing of the winds; the falling of rain; some atoms have been moved from place to place, and they will never return to exactly the same positions in relation to each other.

* "Origin of Species," p. 56.

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Neither is "all the heaven," any more than is this earth, a finished work. The planetary system was formerly believed to be stable—any movement in one direction being compensated for, as in the swing of a pendulum, by a movement in another direction, and the permanency of the existing state of things being thus secured.

The solar system to which our small world is attached cannot, however, be regarded as absolutely established in the position it now occupies.

Our sun, moon, and planets, while moving together, are believed to be themselves travelling as a system of worlds, slowly, through space.

Our sun, constituted as it now is, cannot be expected to shine with the same radiant energy for ever and ever, any more than a fire can be relied upon to send out the same amount of heat during all the winter, without being fed with fresh coal.

Moreover, astronomers are telling us that the various systems of suns, planets, satellites, constituting the universe, must be regarded as "in different stages of their existence."

Mr. Proctor states that it is possible that "each planet, according to its dimensions, has a certain length of planetary life, the youth and age of which include the following eras: a sunlike state; a state like that of Jupiter and Saturn when much heat but little light is evolved; a condition like that of our earth; and lastly, the stage through which our moon is passing, which may be regarded as planetary decrepitude."

Be these things as they may, it is certain that all the stars in the sky have not always been in the same condition as they now are, and that laws are at work by

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which a new heaven, as well as a new earth, is being fashioned. The method of creation, so far as it has already come within the observation of man, involves far more than the simple repetition of past phenomena.

CONCLUSION.

So far as the history of the past can be intelligibly read it justifies the largest and grandest hopes for the future.

Forms of life, more and more richly endowed, have been introduced into the world in succession, epoch after epoch, until man has appeared—a being with a mind capable of studying the mysteries of creation—with a heart to love with strange, deep tenderness—with a conscience to discern the difference between good and evil; and with moral power of sufficient strength and majesty to compel the endurance of suffering, even to the extent of martyrdom, for the sake of Righteousness and Truth.

The Creator who established and maintained the laws in accordance with which a world, which was in the first instance the abode of creatures so lowly as those which crawled on the most ancient shores and swam in the primæval seas, has become a world inhabited by man—may surely be trusted without doubt or fear alike with our own personal destinies and the destiny of our race.

It is impossible to disguise or explain the fact that the production and extinction of the past inhabitants of the world has been brought about by the infliction of pain as well as by the provision for each creature of ample means for the enjoyment of its life. But the method of creation must be judged by its results.

"The most exalted object which we are capable of

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conceiving, namely, the production of the higher animals"—to quote the words of Darwin—"has directly followed from the War of Nature, from Famine, and from Death."

Laws which produce *what is most exalted* among all possible forms of life, although surrounded by the dark clouds of great mysteries, cannot but be regarded as in the highest sense beneficent.

These laws work—again to quote Darwin—"solely by and for the good of each being"—and therefore "*all corporeal and mental endowments will tend to progress towards perfection.*"

The knowledge that we are created by the Power who has fashioned so marvellous a world is enough to sustain the grand hope of the Psalmist that "the Lord will perfect that which concerneth me;" to prevent our ignorance from darkening our faith; and to sustain our confidence in the goodness of our God through all the struggles of our mortality.

When we further remember that the history of our race is the history of an advancing civilization, and that the creative work has been continued by the sending into the world an ever increasing band of philosophers and discoverers, patriots and statesmen, heroes and saints, prophets and martyrs, for its redemption from barbarism and sin—we are more than justified in the conclusion that there is nothing too marvellous—nothing too noble—nothing too sublime—to believe of a Future which is now springing like a flower from the seed sown by the living Present in the soil of the Past.

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